DOCUMENT RESUME

ED 362 276 PS 021 694

AUTHOR Fricker, Jacques
TITLE Putting an End to Diarrhoeal Diseases.
INSTITUTION International Children's Centre, Paris (France).
SPONS AGENCY World Health Organization, Geneva (Switzerland).
REPORT NO ISSN-0379-2269
PUB DATE 93
NOTE 72p.
AVAILABLE FROM Children in the Tropics, International Children's Centre, Chateau de Longchamp, Bois de Boulogne, 75016 Paris, France ($10).
PUB TYPE Collected Works - Serials (022)
JOURNAL CIT Children in the Tropics; n204 1993

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Child Health; Childhood Needs; *Communicable Diseases; *Developing Nations; *Disease Control; Health Promotion; Hygiene; Nutrition; *Oral Rehydration Therapy; Preventive Medicine; Symptoms (Individual Disorders)
IDENTIFIERS *Dehydration; *Diarrhea

ABSTRACT

Focusing on health issues in developing countries, this journal presents information about diarrhoeal diseases and related health problems. The journal is divided into the following sections: (1) "Intestinal Absorption of Water and Electrolytes"; (2) "Diagnosis of Infectious Diarrhoea"; (3) "Hydration and Dehydration"; (4) "Diet and Diarrhoea"; (5) "Home Treatment of Diarrhoea"; (6) "Treatment of Dehydration"; (7) "Prevention of Diarrhoea"; and (8) "Special Cases" (dysentery, persistent diarrhoea, fever and diarrhoea, diarrhoea and AIDS, management of cholera patients, and vaccines). Appendices include treatment plans for diarrhoea and dehydration, a plan for quickly treating severe dehydration, a child growth chart and information for determining if a child is undernourished, as well as guidelines for managing problems associated with diarrhoea. (MM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

CHILDREN
IN THE TROPICS

ED 362 276

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PUTTING AN END TO DIARRHOEAL DISEASES

1993 - N° 204

PS 021694

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
P. Vesin

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

BEST COPY AVAILABLE

INTERNATIONAL CHILDREN'S CENTRE - PARIS

The International Children's Centre was created by the French government in 1949, on the initiative of Professor Robert Debré in particular, following negociations between France and the United Nations. Its purpose was to furnish those international and national agencies dealing specifically with child care with training facilities and educational and informational tools in the field of chid health and development, viewing children within their family and surroundings.

ICC soon turned essentially toward Third World children and devoted its activities to the training and education of personnel with social, educational and administrative responsibilities as well as medical and paramedical workers. The desire for greater efficiency has led it to work increasingly with trainers and to concentrate its efforts on the methodological and educational aspects of mother and child care programmes.

ICC is also engaged in an attempt to further study - and - action on some aspects of the life and health of children and their family, so as to contribute to practical improvement, particularly in the fields of growth, nutrition, planned parenthood, the control of transmissible and nutritional diseases, preschool and school education, the needs of disabled and underprivileged children, etc.

The documentation centre of the ICC has been collecting, processing and circulating invaluable information on children and their environment for the past forty years. In the last decade the centre has also developed the Robert Debré Database (BIRD) ; with its current 110,000 references, it can meet your bibliographic research needs either by correspondence or by visiting the centre's library. Furthermore the ICC also produces the BIRD CD-ROM, updated yearly with the latest database references; it is a user-friendly compact disc operated on any IBM compatible PC equiped with a standard CD-ROM drive. ICC also publishes books, proceedings of symposia and educational documents, as well as comprehensive analyses and bibliographic bulletins.

As for its legal status, the International Children's Centre is a foundation under french law of recognized public utility, administered by an executive board with broad international membership.

CHILDREN
IN THE TROPICS

REVIEW OF THE INTERNATIONAL CHILDREN'S CENTRE

PUTTING AN END TO DIARRHOEAL DISEASES

JACQUES FRICKER
with the collaboration of WHO

1993 - N° 204

Jacques FRICKER

This issue on diarrhoeal diseases was written by Dr. Jacques Fricker, physician and nutritionist at Bichat Hospital (Paris, France), with the help of a number of documents published by the World Health Organization (WHO).

Some chapters were written in collaboration with Dr. Nicole Guérin and Dr. Anne-Marie Masse-Raimbault, with the invaluable counselling of Dr. Hélène Gaumerais.

We wish to express our gratitude to the WHO Department for the Control of Diarrhoeal Diseases and Acute Respiratory Infections (CDR), which kindly accepted to take cognizance of the original manuscript of this publication, and to communicate its most recent recommendations for the management of diarrhoea.

The financial support of WHO for the publication of this issue is also greatly appreciated.

SECRETARIAL WORK SYLVIANE LE BIHAN

TRANSLATION HELEN ARNOLD

Children in the Tropics has been published in French and English for the last 30 years. A new, Spanish edition is in the making, and will be issued in the course of 1993.
All those readers for whom this Spanish edition would be a more appropriate tool are requested to contact us as soon as possible.

PUTTING AN END TO DIARRHOEAL DISEASES

INTRODUCTION		5
INTESTINAL ABSORPTION OF WATER AND ELECTROLYTES	Anatomy	6
	Physiology	8
	Pathophysiological mechanisms	10
DIAGNOSIS OF INFECTIOUS DIARRHOEA		13
HYDRATION AND DEHYDRATION	Distribution of body water	16
	Hydroelectrolytic consequences of acute diarrhoea	17
	Evaluation of dehydration	20
	Degree of dehydration and choice of treatment	22
DIET AND DIARRHOEA		25
HOME TREATMENT OF DIARRHOEA	Increase fluid intake	28
	Continue a normal diet	29
	Learn to recognize deterioration	31
TREATMENT OF DEHYDRATION	Some (but not severe) dehydration	33
	Severe dehydration	36
PREVENTION OF DIARRHOEA	Breast-feeding	39
	Introduction of complementary food	42
	Improving hygiene	44
	Measles immunization	46
SPECIAL CASES	Dysentery	47
	Persistent diarrhoea	47
	Fever and diarrhoea	48
	Diarrhoea and aids	48
	Management of cholera patients	49
	Vaccines	50

Appendix 1 Treatment plan A to treat diarrhoea at home 54

Appendix 2 Treatment plan B to treat dehydration 56

Appendix 3 Treatment plan C to treat severe dehydration quickly 58

Appendix 4 Growth chart 60

Appendix 5 How to determine if a child is undernourished 61

Appendix 6 Management of associated problems 62

DID YOU KNOW[1]? 64

(1) This column will be a regular feature from now on ; it will publish scientific information and news submitted by readers. Your contributions are welcome...

INTRODUCTION

Diarrhoea is the abnormally frequent and/or abundant daily excretion of stools.

In children living in the tropics, diarrhoea is usually of infectious origin. Aside from the possible non-digestive noxious (1) effects of the germ involved, infectious diarrhoea causes complications, which primarily include dehydration and malnutrition : when attacked, the digestive track ceases to play its normal role in the digestion and absorption of water and nutrients. The consequences of this are particularly serious when the child is very young or is already weak, for one reason or another.

Diarrhoea is a major public health problem in developing countries : an estimated 1.3 billion episodes of diarrhoea occur each year, and 3.2 children under age 5 years die of diarrhoea (cf. figure 1).

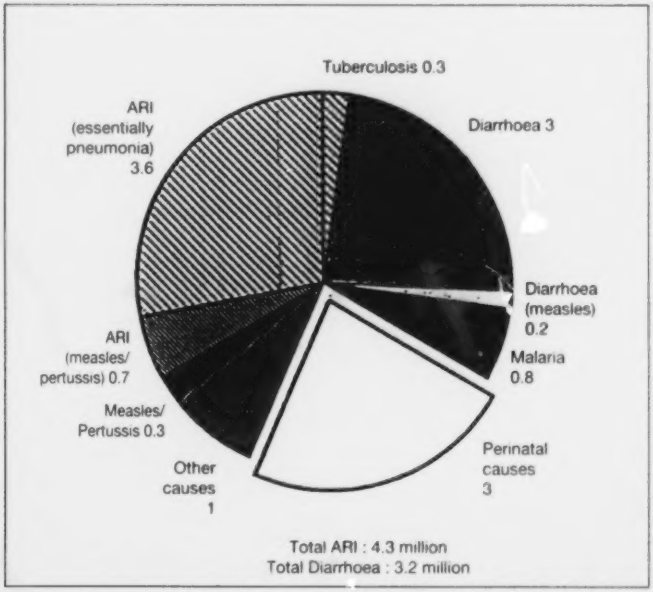


Figure 1 : Causes of the 12.9 million deaths recorded in children under age 5 years (1990). Global estimations.
Source : WHO. Geneva, May 1992, WHO A45-27.

80 % of these deaths affect children under age two. The persistence and/or repetition of infections account for the frequent difficulty in distinguishing between acute and chronic phases of diarrhoea : some young children suffer from it during more than 15 % of the year. Diarrhoea places a heavy burden on the economy of developing countries, since children with diarrhoea occupy up to 15 % of hospital beds. This points to the importance of early detection and treatment of episodes of diarrhoea in children in developing countries. Upstream of this effort, the implementation of preventive measures are the only way to reduce the frequency of diarrhoea and limit its cost, both human and financial. If therapeutic and preventive strategies are to be optimized, the mechanisms of digestive absorption and malabsorption must be elucidated, and knowledge of the infective vectors refined.

---

(1) Health-threatening.

INTESTINAL ABSORPTION OF WATER AND ELECTROLYTES

The mechanisms regulating the flux of water and electrolytes within the intestine ensure the almost total absorption of large volumes of water contained in beverages, food and digestive secretions. When these mechanisms are disturbed by an infection (or any other phenomenon), this absorption occurs improperly or not at all, leading to the loss of water and electrolytes in the stools, and to diarrhoea. Rehydration must then be performed as best, in accordance with the physiology of the intestinal mucosa and with the digestive impairments involved.

ANATOMY

The intestine, an absorbent surface

The intestine is a large surface that works to absorb water and nutrients. Like the other segments of the digestive tube, the walls of the small intestine are composed of five layers. These are, going from the outer layer inward :

- the serous membrane, an extension of the peritoneum ;

- the muscular layer, containing two layers of smooth muscle fibres, one external and longitudinal, the other internal and circular ;

- the submucous layer, made of a dense, conjunctive tissue containing scattered cells along with Brünner's glands in the duodenum ;

- the muscular-mucous layer, a thin layer of muscle fibres ;

- the mucous membrane, in which a single-layered epithelium covers a conjunctive tissue called the lamina propria. It is here that the main mechanisms controlling the absorption of water and electrolytes take place.

The intestine is shaped like a long tube (about 5 metres long in adults). The surface available for absorption is multiplied through several systems : the "closing valves", the villi and the microvilli (cf. figure 2).

The closing valves, or transverse submucosal folds, are covered by the muscular-mucous and mucous layers ; they are up to 1 cm tall, and are macroscopically visible. There are close to one thousand such valves on the entire small intestine.

The villi are outgrowths of the mucous membrane, shaped like the fingers of gloves, and are present all over the small intestine ; there are about 10 million villi, in all. They may be seen with the help of a binocular microscope. Each one is centred around a conjunctival-vascular axis (lamina propria + blood and lymph vessels) and covered by the intestinal epithelium, the cells of which are mostly columnar.

The microvilli within these epithelial cells form the brush border ; there are about 1,700 microvilli per epithelial cell, each one measuring approximately 1 micron.

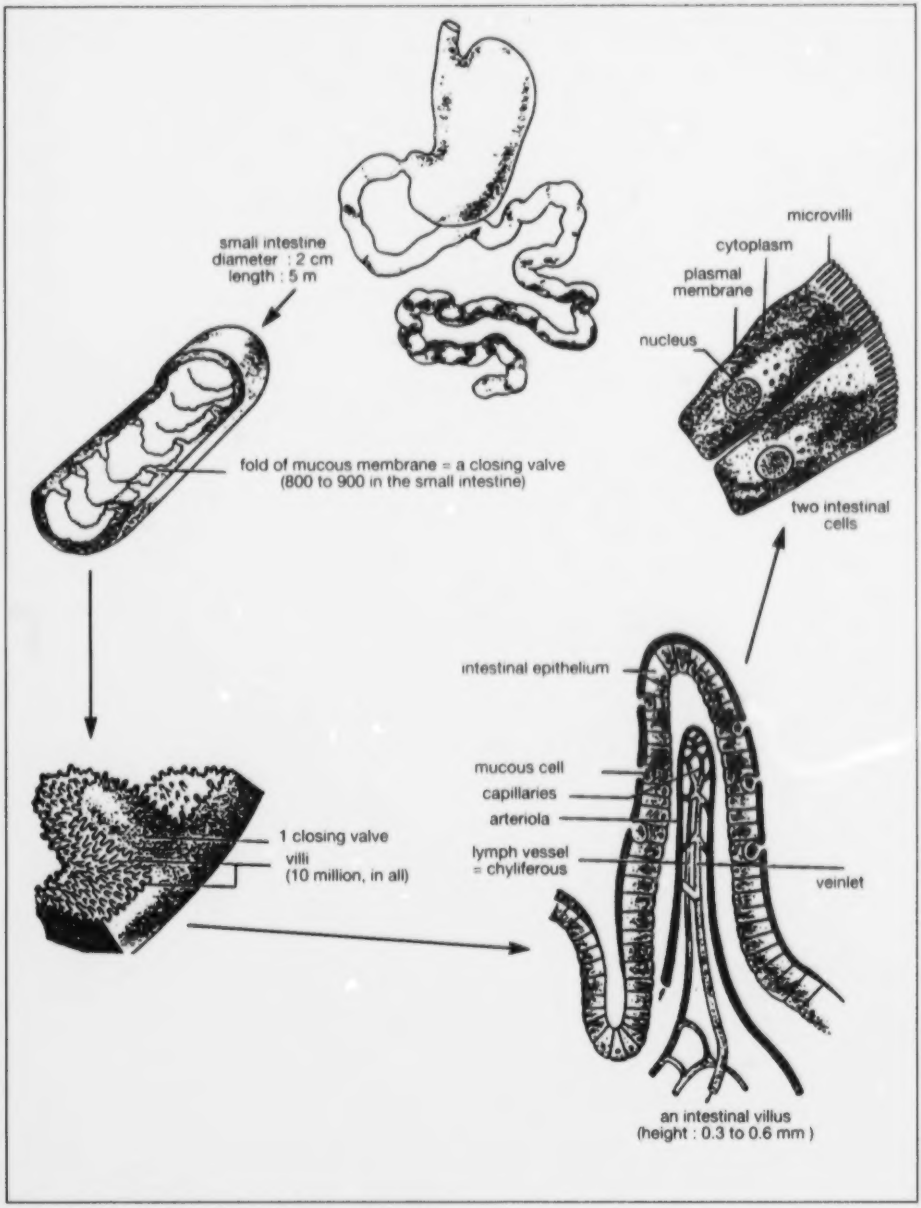


Figure 2 : The small intestine : anatomy and histology.
According to Bordas, science textbook.

The multiplicatory effects of these anatomic-histological characteristics of the small intestine provide it with a considerable absorbent surface (several hundred square metres in adults !). This is indicative of the importance of the exchanges carried on there.

The intestinal epithelium

The processes by which water and nutrients are absorbed begin in the epithelium of the small intestine, which contains a single layer of cells. Most of these are columnar (80 % of all cells) ; the surface on which exchanges take place is multiplied by 30 or 40 by their microvilli. The columnar epithelial cells are packed together tightly ; their bonds seem to be partially permeable by water and electrolytes. The goblet cells are less numerous (15 % in all) : their role is the secretion of a mucus in the gut lumen, which helps move the bolus through the digestive track.

The epithelium projects outgrowths, the villi, on the surface of the small intestine ; further, it invaginates into the lamina propria of the mucous membrane, forming the mucous crypts, or Lieberkühn's glands. The future columnar epithelial cells proliferate on the lower part of these glands, and migrate toward the surface of Lieberkühn's crypts, then to the top of the villi. They achieve maturity in the course of this trip. The migration and differentiation process lasts from 4 to 7 days. Each day, several billions of epithelial cells are renewed (50 in adults). When desquamation is particularly rapid, during certain types of diarrhoea, for instance, the villi grow shorter whereas cell production in the crypts increases ; this protects the epithelial wall.

PHYSIOLOGY

Large amounts of water and electrolytes transit by the small intestine each day. In adults, for instance, there are two litres of fluid in the form of food and drink, plus saliva as well as the secretions of the stomach, pancreas and liver : in all, the small intestine will receive about nine litres. Most, but not all of this fluid is reabsorbed in the small intestine. About one litre reaches the colon, where water continues to be absorbed, although less efficiently : only 100 to 200 ml will be excreted in the stools if the intestinal transit is normal (cf. figures 3 and 4).

In the small intestine, water travels in two directions : water secreted by the plasma moves toward the gut lumen, and simultaneously, there is a movement from the lumen to the plasma. Water and electrolytes are absorbed by the villi and secreted by the intestinal crypts at the same time. Large amounts of water are transported in this way, since 120 to 140 litres of water travel in one direction or another, for a daily intestinal absorption of 8 litres of water.

As opposed to many other body cells such as the red blood cells, columnar cells are asymmetric, which is to say that the carrier systems located on the brush border (in contact with the gut lumen) are not the same as the others. These carrier systems deal with the electrolytes, among others, the movements of which create osmotic gradients ; the latter generate passive water movements, which therefore follow the electrolytes in their travels.

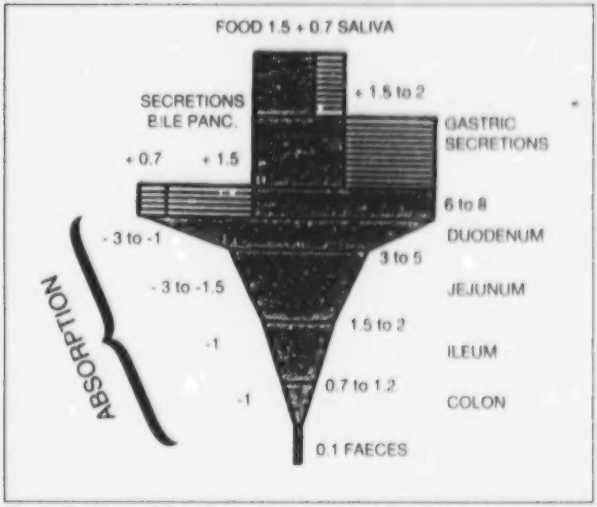


Figure 3 : Flow of fluid through each part of the digestive tract over a 24-hour period (the figures show transit in number of litres per 24 hours).

Source : J-J Bernier et al. Gastro-entérol. Clin. Biol. Paris : Masson, 1979, 3, 399.

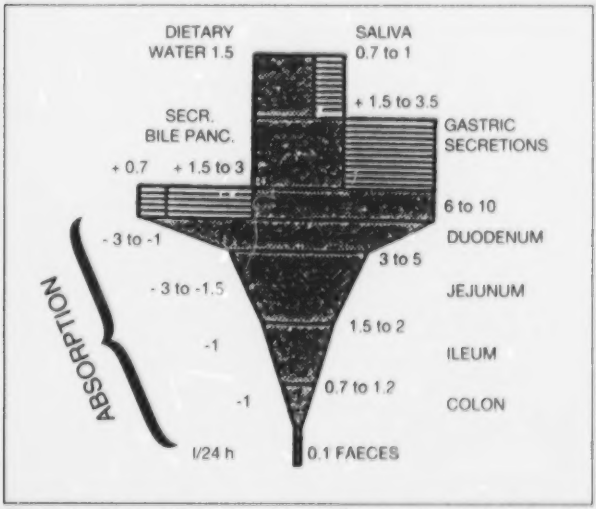


Figure 4 : 24-hour flow of water at different points in the digestive tract (litres/24h).

According to Bernier J-J , Adrian J, Vidon N. Les aliments dans le tube digestif. Paris : Doin, 1988.

Sodium plays an essential role. It has four ways of entering the epithelial cell : by combining with chloride absorption, direct absorption as a sodium ion, being exchanged for a hydrogen ion or linking its absorption with that of glucose or certain amino acids. The addition of glucose to certain electrolyte solutions may therefore triple the reabsorption of sodium by the intestine : this is very important for the treatment of diarrhoea.

Once absorbed, the sodium leaves the epithelial cell by an active system, the "sodium pump", known as Na⁺ K⁺ ATPase. This transfers it into the extracellular fluid, located in the intercellular spaces, in particular, which are changing spaces limited by the lateral membranes of two adjacent columnar epithelial cells. The resulting higher osmolality (1) causes a passive flow of water through intercellular channels, from the gut lumen to the extracellular fluid. This maintains an osmotic balance between the fluids in the intestine and the extracellular fluid of the intestinal tissues. The intercellular spaces are bloated by the arrival of water, then, but the epithelial cells prevent excessive bloating by expelling it to the only free space - that is, downward and to the plasma.

(1) Osmosis : a phenomenon by which two fluids (or solutions) with differing molecular concentrations are diffused through a semi-permeable membrane which may be crossed by the solvent but not by the dissolved substance.

Osmolality : osmotic pressure, expressed in osmols (Osm) or milliosmols (mOsm) per litre of water in a solution.

While electrolytes and water are being absorbed in the intestinal villi, a secretion occurs in the crypts. It is the chloride ion, in particular, which is actively carried from the extracellular fluids to the lumen of the intestinal crypt. This creates an osmotic gradient which generates a passive flow of water and electrolytes from the extracellular fluid to the intestinal lumen, through the intercellular spaces.

Thus, starting with the amount of fluid reaching the small intestine, the water and electrolytes absorbed by the villi as well as the amounts secreted by the crypts determine the volume of water entering the lumen of the colon (cf. figure 5).

PATHOPHYSIOLOGICAL MECHANISMS

Diarrhoea is the consequence of the impaired functioning of the transportation of water and electrolytes at the intestinal level. The result is an increased number and volume of stools ; the risk is essentially one of dehydration, with modifications in the acid-base balance and possible ensuing malnutrition. The infective agents involved may act in several ways, more or less combined depending on the aetiology, the individual and the circumstances.

Secretory diarrhoea

Secretory diarrhoea is induced by the abnormal secretion of fluid (water and electrolytes) in the small intestine. It may be linked with the reduced absorption of sodium by the villi and/or with increased secretion of chloride in the crypts. The outcome is a net loss of water and electrolytes in the form of watery stools, thus causing dehydration. Several types of mechanisms may be at work here.

Enterotoxins

Enterotoxins are polypeptides secreted by bacteria in the gut lumen. They are bound to a specific membranal receptor in the intestinal epithelium and emit a signal through the membrane wall to the cell cytoplasm. This signal disturbs electrolyte transport by reducing sodium absorption and increasing chloride secretion. The prerequisites for secretory diarrhoea are then present, although the intestinal epithelium may remain histologically intact ; in this case the stools are watery, afaecal, devoid of mucous and blood. This mechanism is typical of germs such as Escherichia coli, Vibrio cholerae, Yersinia, Bacillus cereus, Klebsiella and Pseudomonas aeruginosa.

The germs enter the intestinal epithelium and generate inflammatory lesions and possibly ulceration, through the production of cytotoxins. Shigellas produce ulcerations in the ileum and the colon, whereas Clostridia arrive in the rectum and colon with some difficulty. Some strains of Escherichia coli, staphylococci, salmonellas and parasites such as Entamoeba histolytica may be involved. Stools tend to contain blood and mucus.

Crossing of the mucous membrane

Certain bacteria cross the intestinal epithelium and its mucous membrane without causing any apparent damage, then proliferate within the reticulo-endothelial system ; they are then able to invade the rest of the body. This is the case of Yersinia enterocolitica and above all, of Salmonella typhi.

Viruses

Viruses, and rotaviruses in particular, enter the mature epithelial cells located at the tip of the villi. Once these cells are destroyed, villous atrophy ensues, with an attendant reduced absorption of

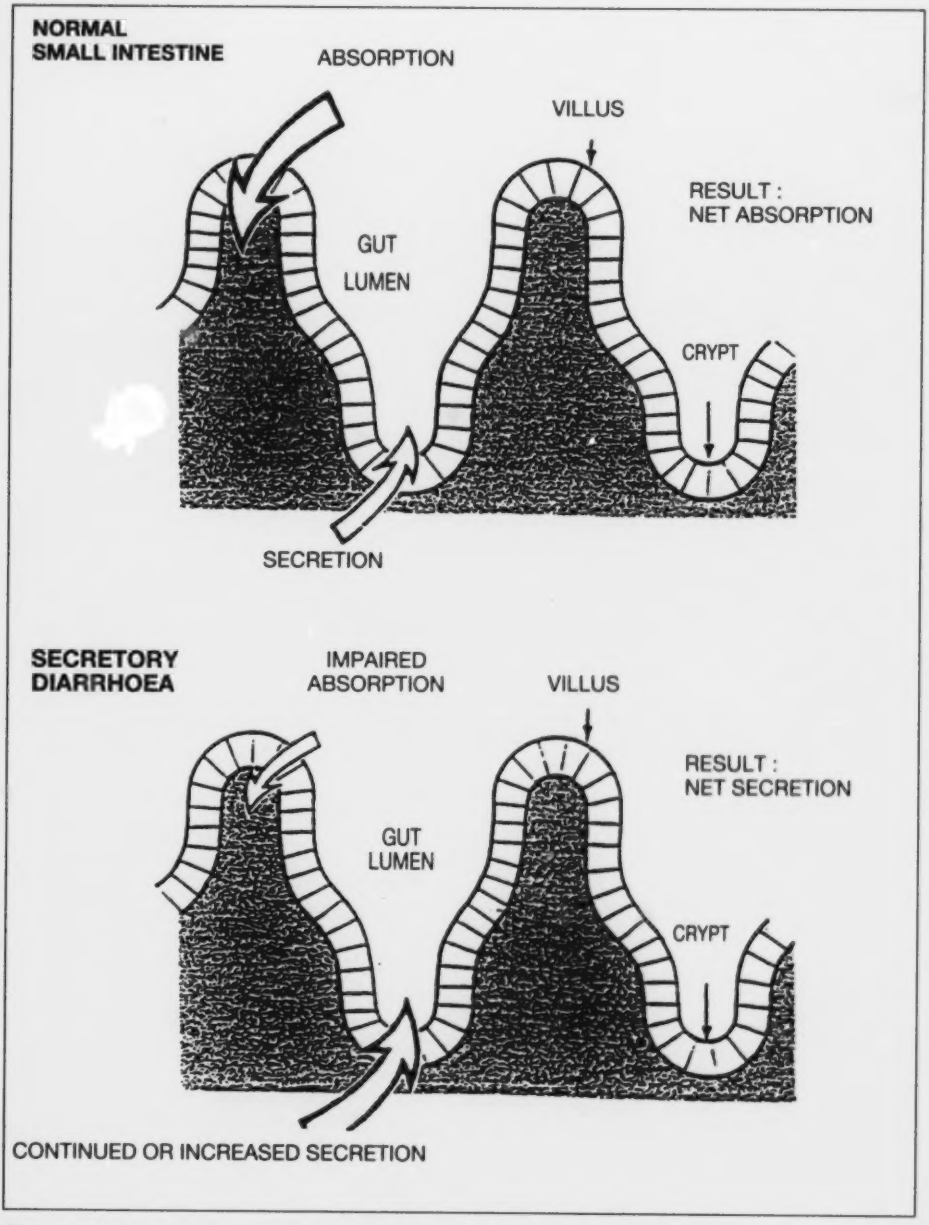


Figure 5 : Absorption and secretion of water and electrolytes by intestinal epithelium.
Source : WHO. Programme for control of diarrhoeal diseases, WHO/CDD/SER/90.13.

water and electrolytes ; the impaired cells are replaced by immature ones with an essentially secretory function produced by the multiplication of cells in the crypts. Further, the intestinal enzymes, and especially lactase, cease to be produced, thus compounding these other mechanisms with osmotic diarrhoea.

Osmotic diarrhoea

When an osmotically active substance is ingested but improperly absorbed, there are two possible consequences. If it is taken in the form of a solution that is isotonic with respect to the blood plasma, the water and the substance transit through the digestive tube without being absorbed (whence the diarrhoea), but without generating any secretion of water by the intestine (whence no dehydration). Certain purges, such as magnesium sulfate, act in this way. If the poorly absorbed substance is consumed in the form of a hypertonic solution, the water goes from the intercellular fluids to the gut lumen, in order to restore the osmotic balance between the two sides of the intestinal epithelium ; the result is diarrhoea with dehydration. In children with lactase deficiency or suffering from malabsorption of glucose (both of which may be temporarily induced by an acute enteric infection), this process is triggered by the ingestion of glucose or lactose.

DIAGNOSIS OF INFECTIOUS DIARRHOEA

Positive diagnosis

In epidemiological studies, diarrhoea is generally defined as the evacuation of at least three loose or watery stools per 24 hours ; a loose stool is defined as one that takes the shape of the container. Breast-fed infants normally pass several loose, semi-liquid stools a day : for them, diarrhoea is diagnosed when stools are more frequent or watery than usual. Questioning of the mother is essential in all cases.

Usually, the diagnosis of diarrhoea is obvious. However, at the very beginning, some signs of dehydration without weight loss may occur even before abnormal stools are seen. They often involve abdominal swelling and gurgling noises, reflecting the accumulation of fluid in the bowels. An x-ray of the abdomen, if performed, would show the presence of fluids throughout the intestines. This non-exteriorized phase lasts a few hours at most. Three different clinical pictures may then be seen.

Acute watery diarrhoea

Acute watery diarrhoea is characterized by the frequent discharge of loose or watery stools, with no visible presence of blood, during a period of no more than two weeks. Diarrhoea is often accompanied by fever, vomiting and spontaneous restricted intake of fluids. The risk is acute dehydration with collapse.

The pathogens most frequently responsible for acute diarrhoea in young children in developing countries are rotaviruses, enterotoxigenic Escherichia coli, Shigella, Campylobacter jejuni and Cryptosporidium. In some regions, Vibrio cholerae 01, Salmonella and enteropathogenic Escherichia coli are often involved as well.

Acute dysentery

Whereas watery diarrhoea is the most frequent clinical form in infants, dysentery is more frequent in older children. Stools are frequent but often not very abundant, containing mucus and above all blood and/or pus. A false urge to defecate is common, along with anorexia and weight loss. The main cause of acute dysentery is the Shigella ; others include Campylobacter jejuni and more rarely enteroinvasive Escherichia coli and Salmonella. Entamoeba histolytica, which causes severe dysentery in young adults, is rarely a cause of dysentery in young children.

Persistent diarrhoea

Persistent diarrhoea may begin suddenly (and be watery or dysenteric) but it is long-lasting (at least fourteen days). Weight loss and malnutrition are often serious ; there is a risk of dehydration when stools are bulky. Many microbial agents may be involved : persistent infectious diarrhoea should not be confused with chronic diarrhoea with a non-infectious cause such as gluten intolerance or a hereditary metabolic disorder.

Aetiological diagnosis

Until recent years, the identification of pathogens in the stools was only feasible in about 25 % of patients with acute diarrhoea. At present, new techniques enable competent laboratories to identify

these pathogenic agents in about 75 % of cases seen in health care establishments, and in up to 50 % of moderate cases detected within the community. Those infectious agents most often connected with diarrhoea in young children in developing countries are shown in table 1.

Table 1

Pathogens frequently identified in children with acute diarrhoea in treatment centres in developing countries

Pathogen		% of cases
Viruses	Rotavirus	15-25
Bacteria	Enterotoxigenic Escherichia coli	10-20
	Shigella	5-15
	Campylobacter jejuni	10-15
	Vibrio cholerae 01	5-10
	Salmonella (non typhoid)	1-5
	Enteropathogenic Escherichia coli	1-5
Protozoans	Cryptosporidium	5-15
No pathogen found		20-30

Certain agents may be more locally disseminated : these include Vibrio cholerae 01 (in pandemic areas and during epidemics), non-typhoid Salmonella (in places where food is not prepared and stored properly, for instance) and enteropathogenic Escherichia coli (in hospitalized infants). Infections combining two or more enteropathogens are present in 5 to 20 % of cases seen in health care units.

The enumeration of the germs causing the enteric infections which lead to acute diarrhoea should not overshadow two facts that are important in practice :

- diarrhoea may be caused by a parenteral infection (that is, one of non-digestive origin), and particularly so in younger children : these include ENT infections (otitis, etc.), respiratory or urinary infections, appendicitis, malaria, bacterial meningitis, or even simple teething. A general examination of the child is necessary, then, especially in infants, and lumbar puncture and/or thick drop should be performed at the slightest doubt ;

- in case of enteric infection, it is usually impossible to identify the germ involved by its clinical features or by laboratory testing. This is rarely necessary, since treatment is the same. Treatment of diarrhoea is based on rehydration and renutrition ; as a rule, neither antibiotics nor antiparasitic agents are needed.

Diagnosis of severity

To establish a prognosis and define treatment, it is essential to assess the degree of dehydration and the child's nutritional status immediately, and to monitor their evolution with treatment ; these two aspects will be discussed in detail further down. However, other points should be considered when examining a child with diarrhoea.

Associated digestive disorders

Even if the initial picture is not very alarming, certain signs are indicative of increasing dehydration. These are : "explosive" or "spurting" stools, presence of vomiting or high fever, anorexia with systematic refusal to take anything into the mouth, etc. A change in treatment plans may then be necessary.

The sociocultural context

When the child is not hospitalized, ambulatory treatment requires the understanding and agreement of the family ; health education as well as monitoring of the course of the diarrhoea through close contact with health workers or trained volunteers are essential. In this case, the child's home must not be located too far from these human resources. Furthermore, an up-to-date immunization schedule is a good prognostic sign, in that it eliminates the possibility that measles is at the origin of the diarrhoea : diarrhoea subsequent to measles is particularly serious and protracted.

HYDRATION AND DEHYDRATION

DISTRIBUTION OF BODY WATER

The total amount of water contained in the human body depends on the phase of growth. Water represents 90 % of the foetal body at the end of the first three months of gestation, and 75 % at birth. This percentage declines during the first year, and reaches 60 to 65 % at adulthood, with slightly higher figures for men than for women.

This water is contained in two compartments separated by water-permeable cell membranes : the intracellular compartment and the extracellular compartment. The distribution of water between the two varies in the course of growth, with a gradual increase in the intracellular/extracellular ratio. In the extracellular compartment, water is present in two areas, as intravascular and the interstitial fluids, separated by capillary membranes.

The electrolyte composition of the intracellular fluids is maintained constant by exchanges with the extracellular compartment, across the cell membranes. The electrolyte composition of these two fluids is extremely different : in terms of osmolality - that is, of the total concentration of particles dissolved in each of the two fluids - a balance is maintained. The osmotic forces of the two compartments determine how much water crosses the cell membranes : water circulates from the medium with the lower osmolality (poorer in electrolytes) to the medium with a relatively higher osmolality (the richer one).

The electrolyte composition of the extracellular fluid is kept constant by the activity of the kidneys, which eliminate waste products and the surpluses of the body's metabolism following filtering, concentration, dilution and reabsorption. The infant's kidneys are still immature and less able to adjust to variations in the concentration of the internal medium. The elimination of water is therefore proportionately greater in infants than in older children and adults.

In some medical conditions such as diarrhoea, the mechanisms regulating the movements of water are impaired or overwhelmed, causing additional losses of water and resulting in clinical signs reflecting severe internal suffering.

Water balance

Under normal physiological conditions, the water balance - that is, the difference between intakes and losses - is in equilibrium. The losses occur in the urine, the lungs (with greater losses if the air is dry and if hyperventilation occurs), the skin (perspiration) and the stools : about 100 ml a day in infants, 200 ml a day in adults, or as much as 500 ml for adults who eat a fibre-rich diet.

The intakes are external, through food and drink, and of internal origin, through oxidation of carbohydrates, lipids and proteins in the tissues.

For a healthy, breast-fed baby weighing 7 kg, the daily water balance, exclusive of intestinal fluids, may be broken down as shown in table 2.

Table 2
Daily water balance - Child weighing 7 kg

Water intake (ml)		Losses of water (ml)	
breast milk	875	breathing	120
oxidation	75	perspiration	240
		urine	475
		stools	100
		retention for growth	15
Total	950		950

As a rule, daily water requirements are determined by age, weight, concentration ability of the kidneys and imperceptible water losses (breathing, perspiration).

In infants, water losses are proportionately higher than in adults. The immature kidney eliminates more water. Breathing is more rapid. The skin surface, in proportion to weight, is greater.

Under normal circumstances, the infant's water requirements are covered by 1.5 ml of water per calorie consumed (for a child weighing 7.3 kg, FAO and WHO recommendations for intakes are 112 kcal/kg/day). At age 5 years, these requirements are down to 1 ml of water per calorie consumed. The infant's extracellular water is completely renewed every 3 days, as against 7 days for adults.

These requirements vary with physiological status and with the climate. They increase under hot climates, and during pregnancy or bouts of fever, for instance. The increment is estimated at about 10 to 20 ml/kg/day for each 1°C of temperature above 37°C.

HYDROELECTROLYTIC CONSEQUENCES OF ACUTE DIARRHOEA

Diarrhoeic stools contain large amounts of water, sodium, chloride, potassium and bicarbonate. All of the acute effects of watery diarrhoea are caused by hydroelectrolytic losses through the stools. These losses are compounded in the case of vomiting, and fever is also a cause of elimination of water. These conditions lead to dehydration (owing to a loss of water and of sodium chloride), acidosis (owing to a base-deficit, through loss of bicarbonate) and potassium depletion. Dehydration is particularly dangerous, since it may cause a decreased blood volume (this is hypovolaemia), cardiovascular collapse and death if treatment is not administered rapidly.

Isotonic dehydration

Isotonic dehydration is the type of dehydration most frequently induced by diarrhoea. It occurs when the net water and sodium losses occur in the same proportions as in the normal extracellular fluid (ECF). The main characteristics of isotonic dehydration are as follows :

- hypovolaemia, owing to substantial losses of extracellular fluid ;

- balanced water and sodium deficits ;

- normal serum sodium concentration (130-150 mmol/l) ;

- normal serum osmolality (1) (275-295 mOsmol/l).

The first signs of isotonic dehydration are thirst, then persistence of skin pinches, tachycardia, dry mucosa, sunken eyes, absence of tears, depressed anterior fontanelle in infants and oliguria. Physical signs of isotonic dehydration are first seen when the fluid deficit nears 5 % of body weight, and increase in severity as this deficit grows. When the fluid deficit nears 10 % of body weight, dehydration is severe, and the following signs develop : anuria, hypotension, a weak, very rapid radial pulse, cold, moist extremities, a semi-conscious state and other signs of hypovolaemic shock. A fluid deficit exceeding 10 % of body weight soon ends in death by circulatory collapse.

Hypertonic dehydration

In some cases, especially in infants, diarrhoea is accompanied by hypernatraemic dehydration. This reflects the fact that more water than sodium is lost, in comparison with the proportions normally seen in the ECF. This is usually caused by the ingestion, during the episode of diarrhoea, of hypertonic fluids (with a high concentration of sodium, sugar or other osmotically active solutes) which are inadequately absorbed, as well as by the insufficient intake of water and other drinks with a low solute density. Hypertonic fluids create an osmotic gradient in the small intestine which attracts water from the ECF to the gut lumen, whence a decreased volume of ECF and a high sodium concentration in the latter (cf. figure 6). The main characteristics of hypernatraemic dehydration are :

- hypovolaemia ;

- water-sodium deficit, with a greater water deficit ;

- high serum sodium concentration (> 150 mOsmol/l) ;

- high serum osmolality (> 295 mOsmol/l) ;

- intense thirst, out of proportion to the apparent degree of dehydration, irritability ;

- convulsions may occur, especially when the sodium concentration exceeds 165 mmol/l.

Hypotonic dehydration

Hyponatraemia

Children with diarrhoea who drink large amounts of water or hypotonic fluids containing little salt or other solutes, or are given infusions of 5 % glucose in water may develop hyponatraemia. The water is absorbed by the intestine, but losses of salt (NaCl) continue, so that the net sodium losses are higher than the water losses.

---

(1) Osmolality : osmotic pressure expressed in osmols (Osm) or in milliosmols (mOsm) per kilogramme of water in a solution

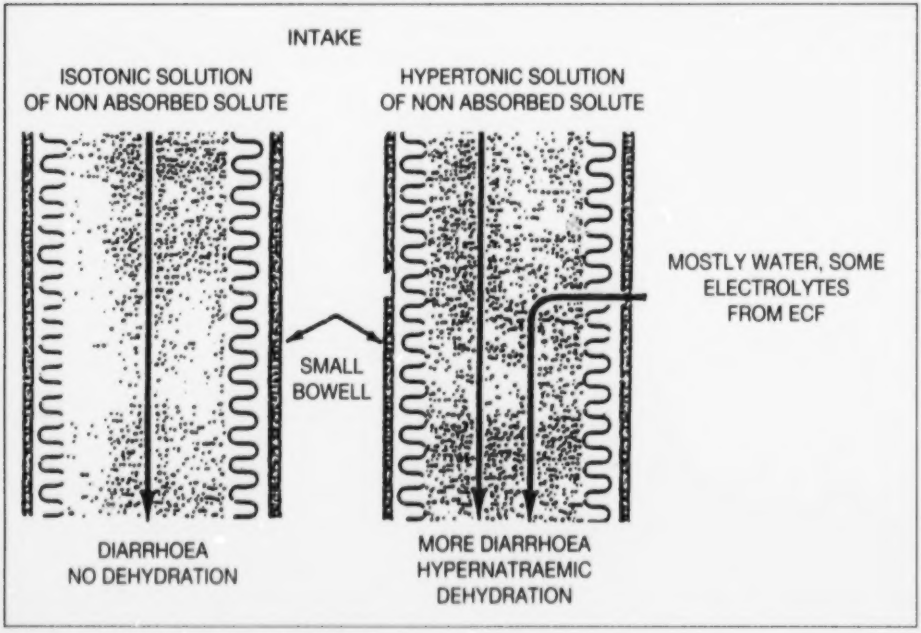


Figure 6 : Mechanisms of osmotic diarrhoea.
Source : WHO ; Programme for control of diarrhoeal diseases, WHO/CDD/SER/90.13.

The main characteristics of hyponatraemic dehydration are :
- hypovolaemia ;
- water and sodium deficit, with a greater sodium deficit ;
- low serum sodium concentration (< 130 mmol/l) ;
- low serum osmolality (< 275 mOsmol/l) ;
- lethargy ; convulsions are infrequent.

Base-deficit acidosis

During diarrhoea, large amounts of bicarbonate may be evacuated in the stools. If the kidneys continue to function normally, they work actively at compensating for the lost bicarbonate. If the kidney functioning is impaired, on the other hand, this compensatory mechanism does not work : this happens when hypovolaemia results in insufficient irrigation of the kidneys. A base deficit and acidosis then develop rapidly. Acidosis may be caused by excessive production of lactic acid in patients experiencing hypovolaemic shock. The characteristics of base-deficit acidosis are :
- lowered serum bicarbonate concentration, possibly dropping below 10 mmol/l ;
- low arterial pH - possibly below 7.10 ;
- deep, rapid breathing, which contributes to the rise in arterial pH by causing compensatory respiratory alkalosis ;
- increased vomiting.

Potassium depletion

Patients with diarrhoea often suffer from potassium depletion owing to heavy faecal discharge of potassium ; these losses are particularly great in infants, and may be extremely dangerous in undernourished children who often already suffer from potassium deficiency prior to diarrhoea. When losses of potassium and of bicarbonate occur simultaneously, hypokalaemia is generally avoided. This is because the metabolic acidosis resulting from the loss of bicarbonate causes the potassium-rich intracellular fluid to travel to the ECF in exchange for hydrogen ions, thus maintaining a normal, and sometimes even a high serum potassium concentration. Conversely, when metabolic acidosis is corrected by the administration of bicarbonate, this exchange is rapidly reversed, and severe hypokalaemia may occur. This may be avoided by replacing potassium, while correcting the base deficit at the same time. The usual signs of hypokalaemia are :

- general muscular weakness ;

- cardial arrhythmia (risk of cardiac arrest) ;

- paralytic ileus, especially when medications which also depress intestinal peristalsis (opiates, for instance) are administered.

EVALUATION OF DEHYDRATION

Assessment of the illness begins with the detection of signs of dehydration, followed by investigation of any other problems, which may or may not be linked with the diarrhoea. This is usually done before treatment is begun. However, if the child is severely dehydrated, the complete examination and study of past history are postponed, and treatment is begun immediately. When the child is in a stupor and the existence of diarrhoea and vomiting at the start of this condition is corroborated, when a quick check of the skin pinches shows them to be quite abnormal, there can be no hesitation about diagnosing severe dehydration, and setting up an infusion immediately. Once the latter is functioning, questioning and the physical examination may be completed.

Signs of dehydration are detected through questioning, observation and palpation.

Questioning

Certain points are useful in identifying children who run an increased risk of dehydration. These include vomiting, fever and decreased fluid intake. Conversely, the risk of dehydration is lower in case of breast-feeding and/or fluid intake in the form of water, oral rehydration salts or recommended home preparations during the episode of diarrhoea. However, the main information needed includes :

- duration of diarrhoea ;

- consistency of the stools ;

- presence of blood in the stools ;

- whether fever, convulsions or other problems are present ;

- feeding practices before the illness ;

- type and amount of fluids (including breast milk) and of solid foods ingested during the illness ;

- drugs and other treatments administered.

Looking and feeling

The six signs used to evaluate dehydration (cf. table 3) are as follows :

General condition

- general condition and behaviour. The child's general condition should be carefully assessed, and his/her behaviour observed. Does the child seem well and alert? Restless and irritable? Floppy (listless), lethargic or unconscious? It is sometimes difficult to determine whether a child is abnormally lethargic or simply sleepy. To find out, it is often enough to ask the mother or the accompanying person.

Eyes

- eyes. Are the child's eyes normal? Sunken? Very sunken and dry? Note that some children normally have slightly sunken eyes. It is often helpful to ask the mother whether her child's eyes are normal or more sunken than usual.

Tears

- tears. Does the child shed tears when he/she cries?

Tongue

- mouth and tongue. Are the child's mouth and tongue moist? Dry? Very dry? This may be determined by touching the tongue and the inside of the mouth, using a clean, dry finger. This sign is not entirely dependent on dehydration, however : the mouth and tongue will be moist if the child has been drinking or has vomited recently ; they will be dry if the child breathes through the mouth.

Thirst

- thirst. The child's eagerness to drink is tested by offering him/her a little water in a cup or spoon, and seeing whether he/she drinks normally, accepts the water without showing any particular interest, or refuses to drink. He/she may drink eagerly, grasp the cup or spoon, visibly want to drink or be in a state of lethargy or semi-consciousness and therefore incapable of drinking or drinks very poorly.

Skin pinch

- skin pinches. When the skin of the abdomen or thigh is pinched and released, does the pinch disappear immediately? Slowly? Very slowly (more than 2 seconds)? This sign is generally very valuable, but obese children may have seemingly normal skin pinches even in case of dehydration, because of the presence of a layer of fat under the skin. Conversely, in marasmic children (with severe wasting) the skin pinch may be suggestive of dehydration even when they are not dehydrated.

Fontanelle

Other signs, not included in table 3, may be useful :

- anterior fontanelle. In infants with definite signs of dehydration, the anterior fontanelle is more depressed than usual. In case of severe dehydration, it is very depressed. To examine the fontanelle, the child must be lying down and if possible, calm.

Arms and legs

- arms and legs. The skin is abnormally warm and dry at the extremities. The nail beds are normally pink. With severe dehydration and hypovolaemic shock, the skin turns cool and moist and the nail beds may be cyanosed.

Pulse

- pulse. As dehydration increases, the radial and femoral pulses become more rapid. The radial pulse then becomes very rapid and weak. In case of hypovolaemic shock it may disappear completely. The femoral pulse can still be felt however.

Breathing

- breathing. Children with severe dehydration breathe rapidly, partly because of their base-deficit acidosis. The absence of coughing or chest-indrawing eliminates the possibility of pneumonia.

It is more difficult to evaluate dehydration in undernourished children. Indeed, in case of severe malnutrition, the signs pertaining to the child's general state and behaviour, the sunken eyes, absence of tears and pinched skin elasticity are all modified. However, examination of the mouth and tongue and eagerness to drink are still good signs. A malnourished, dehydrated child has a dry mouth and tongue and drinks eagerly when offered water. In case of severe dehydration, the mouth and tongue are extremely dry, the extremities are cool and moist, and the radial pulse is weak or disappears.

Following examination of the patient, the findings must be analysed, to determine the degree of dehydration (if any) and to choose the proper treatment. Signs indicative of dehydration are shown on a record chart which lists them in three columns (A, B and C), corresponding to different degrees of severity.

DEGREE OF DEHYDRATION AND CHOICE OF TREATMENT

As the patient is examined, each of the signs enumerated on the left hand side of the chart is evaluated, and the description in column A, B or C which corresponds best to the sign observed in the patient is circled. The signs most distinctive of dehydration, called "key signs", are designated by asterisks (*). Two or more circled signs in the same column, including at least one key sign, mean that the patient falls in this category for dehydration, and should be given the corresponding treatment plan. If signs in more than one column are marked, as often occurs, the dehydration category is the one farthest to the right (of the columns A, B and C) in which two points, including at least one key sign, are circled.

The six signs shown in the table above were selected and recommended by the World Health Organization (WHO) in 1990 for the assessment of the degree of dehydration in a child with diarrhoea. Prior to that date, six other signs (frequency of stools during the last 24 hours, vomiting, urine, breathing, pulse, fontanelle) were included in the treatment chart as criteria for the assessment of dehydration. Experience has shown, however, that these signs were either too specific for the detection of dehydration or too difficult to teach to health workers.

In severe dehydration, the patient's fluid deficit exceeds 10 % of his/her body weight, whereas it is between 5 and 10 % in cases where signs of dehydration are clearly present but are not severe. Even when dehydration does not exceed 5 % of the diarrhoeic

Table 3
Evaluating the degree of dehydration.
Choosing the treatment plan

	A	B	C
1. LOOK AT :			
CONDITION	Well, alert	"Restless, irritable"	"Lethargic or unconscious ; floppy"
EYES	Normal	Sunken	Very sunken and dry
TEARS	Present	Absent	Absent
MOUTH AND TONGUE	Moist	Dry	Very dry
THIRST	Drinks normally, not thirsty	"Thirsty, drinks eagerly"	"Drinks poorly or not able to drink"
2. FEEL :			
SKIN PINCH	Goes back quickly	"Goes back slowly"	"Goes back very slowly"
3. DECIDE :	The patient has NO DEHYDRATION	If the patient has two or more signs, including at least one "sign", there is SOME DEHYDRATION	If the patient has two or more signs, including at least one "sign", there is SEVERE DEHYDRATION
4. TREAT :	Use treatment plan A	Weigh the patient, if possible, and use treatment plan B	Weigh the patient and use treatment plan C URGENTLY

child's body weight, a fluid deficit usually does exist nonetheless : these young patients should therefore be given more fluid than usual, to prevent the development of clinical signs of dehydration.

Here is a concrete example of use of the record chart to assess signs of dehydration and their severity, choose a treatment plan and identify any other signs or symptoms. As signs are seen, a mark is made on the assessment card.

A mother consults the health centre for her 18 month-old son, Pano. She is worried because Pano has had diarrhoea for the last 3 days. You question the mother and learn that the child has been drinking large amounts of water, but urinates very little. He has

already vomited twice today. You notice that Pano's eyes are a bit sunken, his mouth and tongue are very dry, and his breathing is normal. When you pinch the skin of his belly, the pinch is doughy. When offered a drink, Pano drinks eagerly. His pulse is somewhat rapid, but strong, and his temperature is 39°C. Pano is grouchy, tense and cries when examined. He has tears in his eyes.

Pano is suffering from a high fever (39°C). His fever should be treated in the customary way for the region. He shows obvious signs of dehydration (4 signs in column B, 3 of which are key signs). Treatment plan B should be chosen (1).

(1) Treatment plans A, B and C are summarized in appendices 1, 2 and 3.

DIET AND DIARRHOEA

Interaction between diarrhoea and nutritional status

Diarrhoea is a major cause of malnutrition, since nutrient needs increase during diarrhoea as they do in all infectious diseases, whereas the intake and absorption of nutrients are usually decreased. Each episode of diarrhoea may cause a weight loss and slow growth. Furthermore, if diarrhoea recurs frequently, there may not be a long enough time lapse between episodes for sufficient "catching up" : the growth curve then falters in comparison with the reference curve (it levels off). Children with frequent episodes of acute diarrhoea or with persistent diarrhoea run a greater risk of undernutrition than those who only experience infrequent or shorter episodes of diarrhoea. Generally speaking, the consequences of diarrhoea for nutritional status are proportionate to the number of days a year during which the child suffers from diarrhoea.

Conversely, malnutrition contributes to the diarrhoea problem. In children who suffer from malnutrition as a result of an inadequate diet, previous episodes of diarrhoea or a combination of the two, episodes of acute diarrhoea tend to be longer and probably more frequent ; persistent diarrhoea is also more frequent, and dysentery is more severe. The risk of death owing to an episode of persistent diarrhoea or to dysentery is considerably increased when the child is already malnourished beforehand.

Thus, diarrhoea and malnutrition combine to form a vicious circle, possibly ending in death if it is not broken ; the terminal event may be a particularly severe or prolonged episode of diarrhoea, or, in case of severe malnutrition, another serious infection such as pneumonia. In fact, deaths due to diarrhoea are generally linked with malnutrition : in hospitals where dehydration is adequately treated, children practically never die of diarrhoea unless they are malnourished.

Factors favouring malnutrition in the course of diarrhoea

Reduced food intake

Food intake may drop by 30 % or more during the first days of acute diarrhoea, owing to anorexia and vomiting, which may discourage any attempts at feeding. However, the food offered may also have a lower nutritional value, or feeding may be interrupted. The latter two situations may be the outcome of traditional beliefs as to how diarrhoea should be treated, or of recommendations by health workers, who advise "putting the bowels to rest".

Decreased absorption of nutrients

The overall absorption of nutrients is also reduced by about 30 % during acute diarrhoea ; more so for fats and proteins than for carbohydrates. In undernourished children suffering from persistent diarrhoea, the deficit may be even greater owing to extensive damage to the intestinal mucosa.

Increased nutrient requirements

During diarrhoea, nutrient requirements are increased because of the increased metabolic demands linked with fever ; furthermore, there is the need to repair the damaged intestinal epithelium, and to replace the blood proteins lost by the impaired intestinal mucosa through exudation, as is the case in dysentery.

Effects of eating during and after diarrhoea

To prevent slowing of growth, a satisfactory diet should be maintained during and after any episode of diarrhoea. Large amounts of nutritious food should therefore be given throughout the episode and convalescence. As a general rule, during diarrhoea, the child should be given the same food as when he/she was well, since most of the nutrients are still digested, absorbed and utilized. During convalescence, compensation for much of the growth retardation may be achieved.

Eating and diarrhoea

The widespread idea that people with diarrhoea should eat little or nothing reflects the common belief that by feeding the patient the volume of the stools is increased, thus worsening diarrhoea ; this is generally untrue, however. Food is usually well tolerated during diarrhoea, except in case of lactose intolerance, and more exceptionally, of intolerance of milk proteins other than those found in breast milk. Such intolerance is unusual in cases of acute diarrhoea, but may be a serious problem in children with persistent diarrhoea.

Feeding during diarrhoea

A large proportion of the food ingested during diarrhoea is digested and absorbed. It is not surprising, then, that children given absolutely normal food rations during an episode of diarrhoea continue to gain approximately as much weight as under normal conditions, whereas those whose rations have been reduced do not grow much, and may even lose weight. There is no justification for feeding a child less during diarrhoea. To the contrary, a complete diet should be maintained to prevent or at least reduce growth retardation and deterioration of the nutritional status.

It is advisable to feed children every 3 or 4 hours (6 times a day) and to give them as much food as they want.

However, even if a child receives all the food he/she wants during an episode of diarrhoea, some growth retardation may occur. Furthermore, many children are already undernourished before they develop diarrhoea, and they will continue to be exposed to a greater risk of frequent, severe or prolonged episodes of diarrhoea until their nutritional status improves.

Feeding following diarrhoea

When the diarrhoea is over, children should continue to receive the same energy-rich foods, and one additional meal a day, for at least two weeks. The aim of this diet is the resumption and consolidation of an adequate growth curve.

It is best to make sure that the child's usual diet provides enough energy and essential nutrients. However, nutrient-rich food supplements are valuable during the first weeks of convalescence, when children are generally very hungry and are easily able to absorb 50 % and even 100 % more calories than usual : this contributes to rapid growth, and growth-retarded children may then catch up on growth.

If the child suffers from malnutrition, the supplemental rations should be continued until the child reaches a normal weight for height.

Evaluating nutritional status

Every child with diarrhoea, or with any other medical condition, should be given a nutritional check-up for the evaluation of nutritional status and before giving any dietary guidance.

People in close contact, and the mother in particular, are questioned to determine the child's usual diet (before the illness) as well as any changes made since the onset of diarrhoea. Mothers will be more effectively counselled on nutrition if their conceptions and beliefs as to the value or danger of various foods in case of diarrhoea, and the role of food and diet in children's well-being are known.

Clinical examination permits the immediate diagnosis of marasmus ("little old person's face", extreme thinness, fleshless extremities, lack of subcutaneous fat, agitation, bloated belly) or of kwashiorkor (oedema, apathetic appearance, dry, flaking skin, enlarged liver, fragile, discoloured hair). Sometimes these two extreme forms of malnutrition coexist. Often, however, undernutrition is less severe, but its extent must be specified, using measurement of weight for age, weight for height and height for age (1). In some emergency situations, measurement of arm circumference may be resorted to (2). Each of these measurements should be interpreted by comparison with the national or international reference charts and tables. If international references are used, they should be interpreted in the local context, and in conformity with the national guidelines. Last, signs of more specific deficiencies, and of vitamin A and iron deficiencies in particular, should be sought.

---

(1) Cf. appendix 4.
(2) Cf. appendix 5.

HOME TREATMENT OF DIARRHOEA

Home treatment of diarrhoea (treatment plan A) is used when the child does not show (or no longer shows) any signs of dehydration. Episodes of diarrhoea generally begin at home, but a child seen in a health facility may well suffer another bout some weeks or months after returning home. It is important, then, that mothers be familiarized with how to manage diarrhoea. Three rules preside over home treatment of diarrhoea : first, increase fluid intake to prevent dehydration, second, continue a normal diet, or give even more food, and last, learn to recognize signs of increased seriousness of diarrhoea, requiring the intervention of a health worker.

INCREASE FLUID INTAKE

Children with diarrhoea need more fluids than under normal circumstances, because of the losses through the stools and vomiting. Dehydration may often be avoided by giving the necessary extra fluid at the start of the episode.

Intestinal absorption of sodium (and therefore of the other electrolytes and of water) is stimulated by the active absorption of certain molecules contained in food, such as glucose (derived from the digestion of saccharose or of cooked starches) and amino acids (derived from the digestion of proteins). This process continues to function during secretory diarrhoea, although most of the other channels for the intestinal absorption of sodium are impaired. Whenever possible, then, water, sodium, glucose or amino acids should be added to the drinks offered.

As soon as diarrhoea begins, the mother should feed her child larger amounts of home-made drinks such as rice water, soup, fruit juices or simply water accompanying salted food. Food-based fluids (such as coconut milk) are effective because of their high glucose or amino acid content, but salt should be added (3 g of kitchen salt per litre of water), so that the child will get the much-needed sodium.

Food may also include cooked cereals, which provide glucose, or a soup made of legumes, which contains amino acids. Food-based drinks should be prepared in the usual fashion, and should not be diluted.

When sweetened water is given, it should not contain more than 40 g of saccharose (a lump of sugar normally weighs 5 g and a teaspoon of sugar about 4 g) per litre of water, to avoid hyperosmolality in the gut lumen ; this might induce osmotic diarrhoea, thus increasing dehydration and hypernatraemia. This explains why commercial lemonades and fruit juices, which contain too much saccharose (100 to 160 g of sugar per litre), should be avoided. Purgatives and stimulants such as coffee should also be avoided. When a child under age six months is exclusively breast-fed, the mother should continue frequent suckling, and she should offer water in addition, but not food-based fluids.

Oral rehydration salts (ORS) are occasionally distributed by health facilities for use at home : the mother should be reminded that the entire packet of ORS should be mixed with water all at once, and that any solution not ingested within 24 hours should be discarded.

Sometimes mothers make their own sugar-salt solution (SSS). To make proper SSS, the right proportions of salt (3 g of kitchen salt per litre of water) and of sugar (20 g of glucose or 40 g of saccharose per litre) must be respected. Glucose may be replaced by saccharose or table sugar. Simply, the amount of sugar used should be twice as much as the amount of glucose. Saccharose is broken down into glucose and fructose in the intestine, and it is only the glucose that stimulates sodium absorption.

Mothers often find it difficult to memorize or follow this receipt : this results in hyperosmolar solutions, which may contribute to digestive water losses. Food-based fluids are safer ; furthermore, they usually have the added advantage of yielding potassium, and of being prepared with boiled water.

The idea is to give more fluids than usual. To achieve this, the child is given as much fluid as he/she desires. Children under age two years are unable to request a drink ; they should therefore be offered the breast or a drink frequently, and be allowed to suckle or drink as long as they wish. To give a general idea, for each loose stool the recommended amounts of fluid are 50 to 100 ml of fluid for children under age 2 years, and from 100 to 200 ml of fluid for 2 to 10 year-olds. Teaspoons are used for children under 2, followed by a cup rather than a baby-bottle, which is difficult to keep clean. To stimulate the child's appetite and vary nutrient intakes, several types of homemade drinks should be used. In case of vomiting, the mother should stop feeding the fluid for 10 minutes, then resume it slowly, with a spoonful every 2-3 minutes, for instance. Mothers and health workers have noticed that some children refuse to drink ORS because of its taste. Flavoured preparations have been tried, but were not any more successful. Perhaps solutions with a familiar taste should be used. It should be noted, however, that dehydrated children drink ORS eagerly irrespective of its taste.

CONTINUE A NORMAL DIET

Breast milk

Breast-feeding should not be curtailed or interrupted during diarrhoea : on the contrary, it should be pursued as often and as long as the infant desires. Breast milk should be given in addition to the ORS or to the recommended homemade drinks, to replace the fluid lost through the stools.

Other milks or infant formulas

Milk of animal origin and infant formulas should be continued. For infants under 6 months old who do not yet eat semi-solid food, mothers are advised not to dilute milk. This method is perfectly satisfactory for most infants. Special lactose-free preparations, or containing hydrolysed protein should not be used, ordinarily ; they are expensive and are not of any special value for most infants and children with acute diarrhoea.

Semi-solid and solid food

Children aged 4 months or more who are already accustomed to semi-solid or solid food should continue to receive these. For infants aged 6 months or over, semi-solid food should be introduced if this is not already the case. At least half of the energy ration should be furnished by food other than milk. Children should be fed frequently - six times a day or more - and should be encouraged to eat. Here are some suggestions for the choice of appropriate food :

- use locally-produced, well cooked and easy to digest food staples, such as rice, wheat, sorghum, potatoes or noodles ;

- feed staple foods in pureed form ; for infants, make a thick porridge. If soups are given to avoid dehydration, other energy-rich foods should be given to ensure an adequate caloric intake. The child's small stomach capacity should be compensated for by frequent feeding with high-energy-density foods ;

- improve the energy content of the staple food by adding 5-10 ml of vegetable oil per 100 ml of food ; red palm oil is particularly recommended, since it is also rich in carotene and avoids vitamin A deficiency ;

- mix the food staple with legumes (beans, lentils, niebe, soybeans, etc.), cooked thoroughly following removal of the cuticle by soaking. When feasible, add eggs, meat or fish, to improve the protein content ;

- give fresh fruit juices, well-cooked green vegetables, fresh coconut milk or crushed ripe bananas as sources of vitamins and minerals (especially of potassium). They should be prepared just before eating, and the leftovers should not be fed to the child later ;

- food and drinks that are overly sweet (such as purchased lemonade or fruit-flavoured drinks) or salty (factory-made soups, for instance) should be avoided ; avoid fibre-rich foods (fibrous fruit and vegetables, whole grains).

Milk intolerance

A few children with acute diarrhoea, infants in particular, show symptoms of intolerance of milk of animal origin, even when they are fed as directed. This usually occurs when the animal milk or infant formula is the only food given. Milk intolerance is more frequent in children with persistent diarrhoea, and is quite rare in exclusively breast-fed infants. It is evidenced by a marked increase in the volume and frequency of stools when milk is given, and a comparable decrease when no milk is given ; thus, it may deteriorate the child's clinical condition and cause signs of dehydration to develop. However, milk intolerance is often mistakenly diagnosed. The volume and frequency of stools may increase slightly when a child with diarrhoea is fed aggressively. As long as the child's clinical condition is satisfactory (that is, as long as he/she gains weight, eats, is alert and active), these signs are not a cause for concern.

Diet during convalescence

As a rule, the food recommended during diarrhoea should be continued when the latter ceases, but in larger amounts so that the

child can recover, growth-wise. One practical solution is to give the child as much food as he/she wants at each meal, plus one additional meal a day over a two-week period. If the child is undernourished, this policy should be continued until the signs of malnutrition have disappeared. Ideally, regular check-ups should be offered, with monitoring of the child's weight and encouragement and counselling on food and diet for the mother.

LEARN TO RECOGNIZE DETERIORATION

It is essential that mothers be taught how to check on the evolution of diarrhoea, and especially, how to recognize an increase in severity or the onset of dehydration. Mothers should bring their child to see a health agent if his/her state does not improve within three days, or if one of the following signs develops :

- frequent, watery stools ;
- repeated vomiting ;
- noticeable increase in thirst ;
- failure to eat or drink normally ;
- fever ;
- bloody stools.

Drugs

Many drugs or combinations of drugs are sold for the treatment of acute diarrhoea and vomiting. Generally speaking, these drugs are not only costly, they are ineffective and may be dangerous.

There are many number of "antidiarrhoea agents". Some inhibit motility (loperamide, diphenoxylate, codeine, tincture of opium, for instance), others are adsorbents (charcoal, kaolin, attapulgite, smectite), live, cultured bacteria (including lactobacillus, streptococcus faecium). Antiemetics such as promethazine and chlorpromazine are claimed to reduce vomiting. None of these drugs has proved effective in children with acute diarrhoea, and some may have dangerous side effects. None of these drugs should ever be administered to children under age 5 years.

Antibiotics should not be used, except in case of dysentery. Furthermore, only severe cases of cholera may justify treatment with antibiotics. In case of persistent diarrhoea, antibiotics should only be prescribed when an enteropathogen has been isolated.

Abuse of antidiarrhoeal agents, antiemetics, antibiotics or antiprotozoal drugs not only puts a strain on the family budget, but above all, it delays the implementation of rehydration or recourse to a health centre.

Conversely, when a parenteral infection (malaria, otitis, lung disease) is the cause of diarrhoea, specific medication is usually prescribed, and recovery then helps to normalize the intestinal transit.

Education

Irrespective of whether health workers see mothers during an episode of diarrhoea or at some other time, counselling including the 3 rules for management of diarrhoea at home (increase fluid intake,

continue normal feeding and recognize the point when a consultation is essential) will only be effective if the messages are properly assimilated. This means that health workers must be sensitive to the family situation, to its resources and behaviour, and should talk to people in comprehensible terms, giving help and support rather than criticism of attitudes. A variety of educational methods may be used : real-life situations, illustrations, stories, practicing, with questions and answers.

TREATMENT OF DEHYDRATION

Dehydration occurs during diarrhoea if the lost water and electrolytes are not completely compensated for by nutritional intakes. When some obvious clinical signs are seen, the fluid deficit represents at least 5 % of body weight : treatment in a health unit is then necessary to avoid deterioration of the situation.

SOME (BUT NOT SEVERE) DEHYDRATION

When some dehydration definitely exists but is not severe (treatment plan B), children need not be hospitalized, but should be given treatment in a special area within the health facility, named "oral rehydration treatment area" (ORT corner). Their mother's presence is required both for participation in treatment at the facility and to learn the basics of nutrition and rehydration, to be continued at home.

Rehydration salts

Use of the oral rehydration solutions recommended by WHO and UNICEF has greatly modified the treatment and prognosis of diarrhoea. Their composition facilitates the absorption of electrolytes as well as of water.

Table 4
Composition of oral rehydration salts weight
(per 1 litre of ORS)

Ingredients	Grammes/litre
Sodium chloride	3.5
Trisodium citrate, dihydrate(1)	2.9
Potassium chloride	1.5
Glucose (anhydrous)(2)	20.0

(1) May be replaced by sodium hydrogen carbonate (sodium bicarbonate 2.5 g).
(2) May be replaced by 22.0 g of glucose, monohydrated or 40.0 g of saccharose (commercial sugar).

Their osmolality should be similar to or lower than that of the blood (that is, about 300 mOsmol or less), while containing enough sodium to compensate for losses caused by diarrhoea. This sodium content is particularly appropriate in case of cholera, but is needed in non-choleric diarrhoeas as well, and does not generate any risk of hypernatraemia.

Table 5
Stool electrolyte content in acute watery diarrhoea and in ORS solution (mmol/l)

Stools		Na^+	K^+	Cl^-	HCO_3^-
Cholera :					
- adults		140	13	104	44
- children (< 5 yrs)		101	27	92	32
In diarrhoea :					
- children (< 5 yrs)		56	25	55	14
ORS solution	Glucose 111	90	20	80	30

Once the emergency rehydration phase is over, ORS should be combined with normal intake of water or breast milk, so that the mean sodium concentration in beverages is close to 50 mmol/l ; this is particularly important for infants, whose kidneys do not yet function completely. The glucose/sodium ratio should be equal to 1/1, at least, so as to maximize sodium absorption. The potassium intake compensates for losses, whereas the citrate (or bicarbonate) corrects the base-deficit acidosis caused by diarrhoea.

Table 6
Molar concentration of ORS ingredients

Ingredients	mmol/litre	
	ORS citrate	ORS bicarbonate
Sodium	90	90
Potassium	20	20
Chloride	80	80
Citrate	10	-
Bicarbonate	-	30
Glucose	111	111

How much to administer

When obvious signs of dehydration exist, the water deficit is somewhere between 50 and 100 ml per kg of body weight. If the child's weight is known, the amount of ORS solution required for rehydration during the first four hours may be calculated by setting the deficit at approximately 75 ml/kg. If the child's weight is not known, the approximate deficit may be determined on the basis of age, although this procedure is less accurate.

Table 7
Approximate amount of ORS solution to administer during the first four hours

Age(1)	under 4 months	4-11 months	12-23 months	2-4 yrs	5-14 yrs	15 yrs or over
Weight (kg)	under 5	5-7.9	8-10.9	11-15.9	16-29.9	30 or over
ORS solution (ml)	200-400	400-600	600-800	800-1,200	1,200-2,200	2,200-4,000

(1) The patient's age should only be used if weight is not known. The approximate amount of ORS required may also be calculated by multiplying the patient's weight (expressed in kg) by 75.

The actual amount given will depend on the patient's desire to drink and by surveillance of signs of dehydration, keeping in mind the fact that greater amounts should be given to heavier patients, those with greater signs of dehydration and those who still have watery diarrhoea during rehydration. The general rule is that patients should be given as much ORS solution as they want, and that signs of dehydration should be checked until they subside.

Older children and adults should be given as much water as they want, in addition to the ORS solution.

How to give ORS

Mothers should be taught how to administer ORS solution to their children. It is best for a demonstration to be given by a nurse or by a health worker, following which the mother feeds the solution to her child under their supervision, respecting the following rules :

- for children under age 2 years, give a teaspoon every 1 to 2 minutes, or offer frequent sips out of a cup, for older children. Adults may drink as much as they like. Try to give the estimated required amount within a 4-hour period.

- if the child vomits, wait 10 minutes, then try again, giving the solution slowly : a spoonful every 2 to 3 minutes.

- if the child wants to drink more ORS solution than the estimated amount, and does not vomit, there can be no harm in feeding him/her more ; if the child refuses to drink the required amount and signs of dehydration have disappeared, rehydration is completed. The treatment plan for non-dehydrated diarrhoeic children is then resumed.

- if the child is breast-fed, nursing should be pursued during treatment with ORS solution.

- non-breast-fed infants under age 6 months should be given an additional 100-200 ml of clean water during the first four hours.

Monitoring rehydration

Mothers should be checked periodically, to make sure they feed the ORS solution correctly, and that their child is really drinking it ; the amount of solution ingested as well as the number of defecations is recorded. When the child is unable to drink, the ORS solution may be administered by nasogastric intubation.

The child's state should be carefully reassessed no more than four hours after treatment was begun. In case of puffy eyelids, a sign of overhydration, the ORS solution should be discontinued but water and/or breast-feeding continued. When the puffiness has subsided, the treatment plan for non-dehydrated children is resumed.

Rehydration is complete when the child no longer shows any signs of dehydration. The child may then be sent home, once the mother has been shown how to continue treatment at home, using ORS and the usual diet.

If some signs of dehydration persist, rehydration treatment should be continued, with administration of the estimated amount of ORS, as shown above. It is important to persevere until all signs of dehydration disappear, and also to offer the child food and other drinks (Treatment plan A).

If the signs of dehydration increase, intravenous rehydration must be temporarily initiated (Treatment plan C).

SEVERE DEHYDRATION

The risk, in case of severe dehydration, is death by hypovolaemic shock : treatment is therefore urgent.

Intravenous rehydration

The treatment of choice in case of severe dehydration is intravenous rehydration, which is the most rapid way to restore the depleted blood volume. Intravenous rehydration is particularly important if signs of hypovolaemic shock develop. These include a very rapid, weak or even nonexistent radial pulse, cold, moist extremities, extreme lethargy and loss of consciousness.

Intravenous treatment demands trained personnel, and sterile needles, tubing, bottles and fluids.

Any accessible vein may be used for intravenous treatment. The most convenient ones are located in the fold of the arm (median arm vein) or, in infants, on the scalp (epicranial veins). In case of hypovolaemic shock, in adults in particular, simultaneous infusion in two veins may increase the blood volume rapidly.

When a peripheral vein cannot be located because of severe hypovolaemia, a needle is inserted in the femoral vein and held there firmly (the femoral vein is located on the medial side of the femoral artery, which is easy to find because it pulsates). A large amount of fluid may then be infused very rapidly. As soon as a peripheral vein appears, the infusion is inserted there. It should not be necessary to bare the vein, since this is not only time-consuming but also involves a risk of infection.

If intravenous treatment is delayed and the patient is able to drink, ORS solution may be administered orally until the drip begins to function.

There is no perfect intravenous solution, capable of compensating the deficits seen in children dehydrated by acute diarrhoea. Different compositions for infusion solutions are available, but some do not contain amounts of electrolytes appropriate for cor-

recting diarrhoea-induced deficits. Ringer's lactate (also called Hartmann's solution for injection) is the preferred commercial solution. When it is not available, a normal saline solution (0.9 % NaCl), half-strength Darrow's solution diluted with 2.5 % or 5 % dextrose, or half-strength saline solution diluted with 5 % dextrose may be used. Intravenous solutions containing dextrose (glucose) only are not acceptable.

Whenever feasible, severely dehydrated patients should be weighed so as to accurately determine the amount of fluid to be administered. In case of severe dehydration, the fluid deficit represents approximately 10 % of body weight (that is, 100 ml/kg).

Infants should be given 30 ml/kg of intravenous fluid during the first hour, followed by 70 ml/kg during the next five hours, so that they will have received a total of 100 ml/kg in six hours. Older children (> 12 months) and adults should be given 30 ml/kg of intravenous fluid in 30 minutes, followed by 70 ml/kg during the following two and one half hours, for a total of 100 ml/kg in 3 hours. In all cases, the level to be reached after each hour of infusion should be marked on the IV fluid bottle.

Following administration of the first 30 ml/kg, the radial pulse should be strong. If it is still quite weak and rapid, a second infusion of 30 ml/kg is given at the same pace, but this is rarely necessary. Small amounts of ORS solution should also be given orally (about 5 ml/kg/hour) as soon as the patient is able to drink, so as to supply additional amounts of potassium and base ; this is generally feasible after 3 to 4 hours (for infants) and 1 to 2 hours (in older patients).

Aside from cases of severe dehydration, the intravenous route is necessary in case of paralytic ileus, severe abdominal distension or severe, repeated vomiting.

Rehydration using nasogastric intubation

If intravenous treatment is out of the question, nasogastric intubation is used to administer ORS solution, provided a competent person is available. This technique is not as satisfactory as intravenous infusion, however, since the fluid cannot be administered as rapidly, and more time is required for its uptake by the intestine. The flow should not exceed about 20 ml/kg/hour ; beyond this figure, abdominal distension and repeated vomiting are frequent problems. When the signs of dehydration do not improve after 3 hours, emergency referral of the child to a facility equipped for intravenous treatment is required.

Oral rehydration

If neither of the two techniques described above are feasible, or if they imply a delay in starting treatment, and if the child is able to drink, ORS solution should be given orally at the dose of 20 ml/kg/hour. This route suffers from the same shortcomings as the nasogastric route ; moreover, it cannot be used in extremely lethargic or unconscious patients.

Monitoring

During rehydration, the child's state should be frequently reassessed - once an hour, at the least - by a health worker, using the six signs mentioned on the treatment chart, until definite improvement is evidenced. Signs of a satisfactory course are resumption of a normal pulse, consciousness, greater skin elasticity, a child who is able to drink much more easily, and who urinates. When these signs are seen, the intervals between assessments may be lengthened. If, on the other hand, the signs of dehydration remain unchanged or grow worse, more intravenous fluid should be given, and more rapidly.

At the end of the expected rehydration period (usually 3-6 hours), the patient's hydration status is carefully assessed. If signs of severe dehydration persist, the same treatment is continued. If not, oral treatment is resumed, using either ORS or food-based drinks, depending on whether some dehydration persists (although not severe) or has subsided altogether. Before the infusion is removed, the child should be offered an oral solution, to make sure he/she is willing to drink it.

PREVENTION OF DIARRHOEA

Propagation of the infectious agents responsible for diarrhoea is usually faecal and oral, that is by the absorption of food or water that has been contaminated at some point in the food chain. Contact with a germ does not necessarily result in diarrhoea.

Certain individual factors affect the incidence, severity and duration of diarrhoea in children. They are : age, the most vulnerable period being between 6 and 11 months, and nutritional status, whence the importance of encouraging satisfactory diet at all ages. Immune status also affects diarrhoea ; immunocompromise may be temporary, as in a viral infection such as measles, or prolonged, as in the acquired immunodeficiency syndrome (AIDS) ; immunosuppression fosters the occurrence of diarrhoea.

Several types of intervention have been suggested to reduce the incidence of episodes of diarrhoea. Analysis of these measures has shown which of them combine effectiveness, feasibility and acceptable cost.

Most actions susceptible of implementation for controlling diarrhoea should take place within the household. However, mothers and other family members can only act properly if they have learned enough about diarrhoea and how to prevent it. Talks with mothers, centred around diarrhoea and its prevention, should be based on the rules for home treatment, and be adapted to the real-life situation, including realistically targeted action.

While education at the health centre may provide information and basic understanding, home visits are required for the improvement of certain habits, attitudes and abilities, through the adjustment of messages to the experience and possibilities of each family. Contacts with families should aim at helping them, understanding them, and enabling them to understand, rather than at criticizing them. The long-term objective is to bring mothers, and even fathers, to realize how important a role they play in the course of their child's health. At the same time, an effort should be made at the school level : schools should communicate knowledge and develop basic behaviour which will gradually become reflex, especially in the field of applied hygiene.

BREAST-FEEDING

Many epidemiological studies have shown the beneficial effects of breast-feeding, both with respect to nutritional status and to infections. Exclusively breast-fed infants have fewer, and less serious episodes of diarrhoea than those fed other milks or infant formulas.

A study conducted in some poor parts of Lima, Peru, has shown that the incidence and prevalence of diarrhoea in children under the age of six months were definitely lower among the exclusively breast-fed than among those who had been given water or tea in addition to breast milk. Formula-fed infants who are given no breast milk had the highest rates (cf. figure 7).

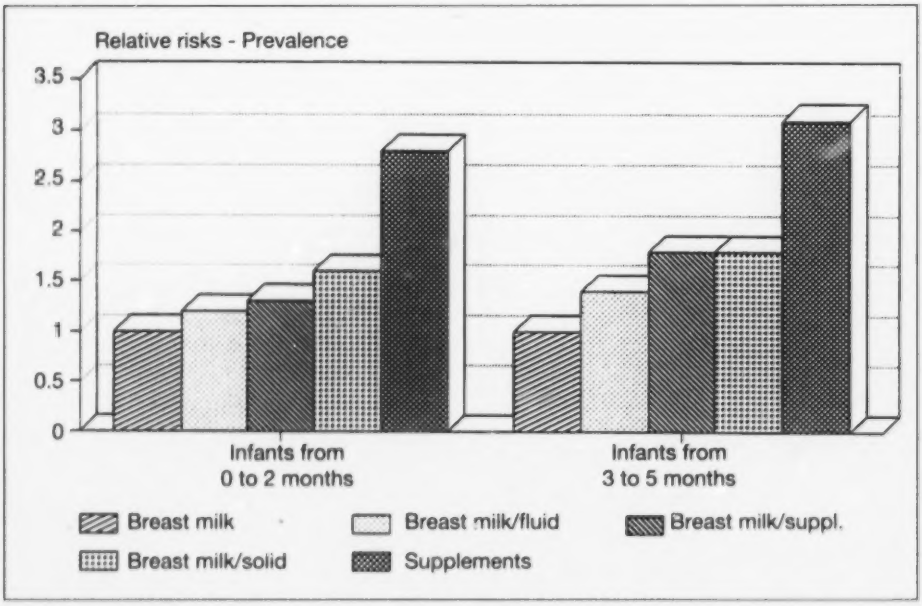


Figure 7 : Age distribution of relative risks of diarrhoea in Peru, depending on type of feeding.
Source : Brown, Black et al. 1989.

Breast-feeding may be encouraged by changing the habits of hospitals, as well as by educating and helping mothers. A survey of 21 studies from eight countries shows that in all probability, the prevalence of diarrhoea in infants receiving no breast milk may be reduced by 40 % in 0 to 2 month-olds, by 30 % in 3 to 5 month-olds and by 10 % in those aged 6 months to one year. Theoretical calculations based on these figures show that moderately widespread action encouraging breast-feeding could reduce diarrhoeal morbidity in proportions ranging from 8 to 20 % and mortality by 24 to 27 % during the first six months of life. For children aged 0 to 59 months, morbidity would be reduced by 1 to 4 % and mortality by 8 to 9 % (cf. table 8).

Table 8
Reduction of diarrhoea-caused morbidity and mortality through breast-feeding

	Age	Reduction (%)
Morbidity	first 6 months < 5 years	8 - 20 1 - 4
Mortality	first 6 months < 5 years	24 - 27 8 - 9

Source : Feachem, Koblinsky. WHO Bulletin, 62 (2), 1984.

Advantages of breast-feeding

The promotion of breast-feeding as a means of preventing diarrhoea should continue to receive attention in both intervention and personnel training programmes. The encouragement of exclusive breast-feeding is recommended during the first 4 to 6 months of life, with partial breast-feeding continued to at least age one year, accompanied by satisfactory food complements.

By definition, exclusive breast-feeding excludes any other intake of water, fruit juices or herb teas.

Breast-feeding has many, important advantages (1).

It is clean : it does not require the use of bottles, nipples, water and formulas which are easily contaminated with the germs that cause diarrhoea.

Breast milk has immunological properties (especially antibodies) that protect the infant against infections, and especially against diarrhoea ; animal milk, powdered milk and various infant formulas do not have these properties.

The composition of breast milk is always adapted to the infant's nutritional requirements ; powdered milk, cow's milk, or any other infant formula, may be overdiluted (which reduces their nutritional value) or too concentrated, and then provide insufficient water and too much salt and sugar.

Breast milk is a complete food ; it provides all of the nutrients and water needed by a healthy infant during the first 4-6 months of life. Low-birth-weight infants benefit from the provision of extra iron, however, if available. There is proof that the mother's nutritional status hardly affects the quality and quantity of milk secreted, unless the mother suffers from severe malnutrition. In the latter case, supplementary food - when available - should be offered the mother rather than the child. Antenatal consultations should detect such mothers so as to enrich their diet as early as possible. Moreover, it should be pointed out that the amount of milk produced is difficult to measure. The image of "mothers who do not have enough milk" is then seen to be particularly unclear.

(1) Cf. Children in the Tropics n° 202/203, 1992.

Breast-feeding is of course far less expensive than artificial feeding (which requires fuel, purchasing of utensils, etc.).

Milk intolerance rarely occurs in exclusively breast-fed infants.

When properly managed, breast-feeding helps with birth-spacing.

Last, breast-feeding has important emotional benefits, and contributes to mother-child "bonding", while affording complete security for the child.

Much has been done to increase the prevalence of breast-feeding, including improved training of personnel on the subject, both in health centres and above all in maternities, along with the fact that "rooming-in" (leaving mother and infant together following delivery) is more frequent. Action aimed at mothers who have home deliveries should be considered, to encourage them to breast-feed. Studies unanimously find that the time when mothers return home after confinement in a maternity is a major turning point : when mothers are helped through this period, they tend to pursue breast-feeding, and it is important, then, to answer their questions and help them to get organized and to deal with any difficulties that may arise. The participation of volunteer mother's advisers, child nurses, home visitors or of any other competent people trained in supporting mothers and talking with them has proved beneficial.

INTRODUCTION OF COMPLEMENTARY FOOD

The age at which complementary food should be introduced is a subject of considerable debate everywhere, since a choice is involved : premature introduction of food increases the risk of infection and especially of diarrhoea, and also results in reduced milk production - owing to the decreased number of feeds - and therefore to reduced immunological protection. If food is introduced too late, the nutritional status may be jeopardized. The question, then, is one of weighing the advantages and the risks, and of making a choice.

Between 4 and 6 months, infants are first given complementary food in the form of porridges made of local food staples, usually cereal grains. Breast-feeding should be continued until the child is 1 to 2, since even in small amounts of breast milk still provide high-quality nutrients, and continue to afford protection against all sorts of infections, including diarrhoea, while the child's own immune system is developing.

There is no doubt that this is a difficult period. Often the quality and quantity of food given (its protein/energy value or cleanliness), the preparation and cooking of food, the way the child is fed, or the frequency of meals is found wanting.

An inadequate diet results in deterioration of the nutritional status and consequently increases the severity, duration and possibly the incidence of episodes of diarrhoea. Inadequacy may mean low-energy, insufficiently nutritious food, as in the case of the watery porridges or bread soaked in herb tea so frequently fed to children

in certain disadvantaged settings. It may also be the result of insufficient amounts of food. Young children have small stomachs, and if they are offered only a few meals, and/or bulky, low-energy foods, their consumption will not cover their nutritional requirements. This is the case, for instance, in regions where porridges are cassava-based. The amount of cassava flour (yucca) - or of flour made of any other tuber - required to make a sufficiently energy-rich food with an acceptable consistency is much too great for the stomach capacity of a young child to absorb in one or two eatings a day. Furthermore, the protein content of some tubers is extremely low, and should be completed with animal or plant protein (from legumes).

Research is presently being conducted to enhance the energy value of certain foods used for weaning. For example, fermentation and sprouting, based on improved traditional techniques, are being experimented, the objective being an increased energy density and elimination of harmful bacteria. An attempt is also being made to limit the swelling of starches, using enzymes.

When complementary food is introduced, the problems that arise involve the child's digestive capacity and the risk of contamination, as well as nutritional value. The small child's digestive track is not fully mature, and the sudden introduction of legumes, for instance, which are rich in plant protein but also contain much cellulose, may cause digestive disorders.

In some cassava-based receipts, with a low protein content, the addition of a legume is recommended when animal protein, often costly and hard to procure, is not available. The result will be satisfactory if the food is well prepared - for instance, if beans are soaked to eliminate the cellulose cuticle, then cooked thoroughly. This requires first that fuel be available, and secondly, that mothers be taught to do this, unless a prior study has shown it to be a common practice simply requiring improvement and adaptation to children's needs.

Mothers should be taught how to choose, prepare, feed and store weaning foods which correspond to their child's nutritional requirements, and how to minimize the risk of microbial contamination. Advice includes :

- wash hands before preparing weaning foods and before feeding the baby ;

- prepare the food in a clean place, using utensils that have been washed beforehand ;

- cook or boil food thoroughly ;

- whenever possible, prepare food just before feeding the child ;

- cover food that is being kept, and store it in a cool place, or refrigerate it when possible ;

- if cooked food is prepared more than two hours before use, reheat it just before giving it to the child ;

- feed the child with a clean spoon, from a cup or with a special feeding spoon. Feeding bottles and nipples should never be used ;

- wash uncooked food in clean water before feeding it to the child ; fruit that is peeled just before eating, such as oranges or bananas, is an exception.

Two recommendations :

- before implementing any improvement strategy, it is important to be familiar with local practices, since modifications do not necessarily improve the situation ;

- it is a fact that in many places, small children are fed complements in the form of a porridge purchased from street vendors, for which neither the formula, the date of preparation nor the degree of cleanliness is known. If such is the case, action should concentrate on educating these women vendors, rather than on mothers.

IMPROVING HYGIENE

Since most of the pathogenic germs which cause diarrhoea are essentially transmitted faecally and orally, the improvement of personal, household and community hygiene contributes to the control of direct transmission. It is estimated that in some settings, improved hygiene might reduce the incidence of diarrhoeal diseases in children under age five by 14 to 48 %.

Families may be helped to act at several levels, starting with better use of water, better personal hygiene (hand-washing), more frequent, adequate use of latrines and proper storage of food.

Use of water

Families in which clean water is available for drinking and food preparation are less subject to diarrhoea than those with no ready access to such water, or whose drinking water is heavily contaminated. The improvement of the water supply may be achieved through government-supported programmes, but also through individual action :

- protect sources of water by keeping animals away, locating latrines at least 10 metres away and downhill from them, dig drainage ditches to divert storm-water, etc. ;

- respect the rules of hygiene in collecting and drawing water ;

- collect and store drinking water in clean containers. Keep the container covered, and do not allow children or animals to drink from it. Do not allow anyone, and especially not a child, to put his/her hand into the storage container. For drawing water, use only a long-handled dipper, especially reserved for this purpose. Empty and rinse the container once a week ;

- boil water that will be used to make food or drinks for young children, and the rest of the drinking water if enough fuel is available. A few seconds suffice ; prolonged boiling is unnecessary and a waste of fuel.

Hand-washing

Parents can help to protect young children against diarrhoea by adopting certain hygiene practices such as hand-washing, which is particularly effective when done properly.

In many families, hand-washing after defecation and before feeding a child is habitual. Relatively little is known about the impact of this behaviour, and about the minimal norms to be respected for it to be really effective. Nor do we know how important people feel these practices to be.

Proper hand-washing requires soap, which is not always available; a local substitute (mud, ashes, sand, etc.) is then used. It also requires plenty of water, and the careful cleaning of the fingers and palm of the hand, as well as of the nails.

All family members should wash their hands thoroughly, especially after cleaning a child who has defecated, after disposing of a child's stool, after defecation, before preparing a meal, before eating and before feeding a child.

Studies have shown that hand-washing is particularly effective in preventing the propagation of shigellosis. In a survey of households in Bangladesh, for instance, it was found that when a case of shigellosis was detected, hand-washing using soap and water reduced the incidence of secondary cases of shigellosis from 14 % to 2 % (Khan M.U. Transactions of the Royal Society of Tropical Medicine and Hygiene, 1982, 76 : 164-168).

In one part of Guatemala, an educational programme concentrating on hand-washing, with measurement of its impact on the incidence of diarrhoea, has been launched. Specific hand-washing practices were encouraged : place water in a specially conceived container, from which it only runs in a trickle, and arrange a spot close to the kitchen, specially equipped for hand-washing. The final outcome of this is not yet known.

Use of latrines

Human faeces should be disposed of in a way that avoids contact with hands as well as contamination of any source of water. Each family should have and use a clean, well-maintained latrine, covered to avoid open-air evacuation.

If no latrines are available, people should defecate at a distance from homes and from children's playing areas, and at least 10 metres away from any source of water ; faeces should be covered with dirt. Children should be taught not to go alone to the places reserved for defecation, and care should be taken to avoid having their hands touch the ground in the surrounding area.

Disposal of stools

In many communities, the stools of infants and young children are considered harmless. However, young children are frequently infected with enteric pathogens, and their stools are actually a major source of infection for others. This is true both for children with diarrhoea and for those with asymptomatic infections.

Older children should be taught to defecate into a container ; the stools should then be immediately emptied into a latrine, and the container washed out. Alternatively, very young children may be placed on a newspaper or a large leaf for defecation, after which the stool is wrapped up and disposed of in the latrines, or buried.

A child who has defecated should be promptly cleaned, and the person's own hands as well as the child's should then be washed in soap and water. Garbage and waste disposal should also be organized, with processing or burial.

MEASLES IMMUNIZATION

Children with measles, or who have had the disease recently, run a substantially increased risk of developing severe or fatal diarrhoea or dysentery (there is some evidence that this increased risk lasts up to six months after measles). Because of the strong relationship between measles and severe diarrhoea, and the effectiveness of the measles vaccine, measles immunization is a very cost-effective measure for reducing diarrhoea morbidity and deaths. When administered at the recommended age, the measles vaccine can prevent up to 25 % of diarrhoea-associated deaths in children under 5 years of age.

SPECIAL CASES [1]

DYSENTERY

Dysentery is diarrhoea with visible blood in the stools ; pus or mucus may also be present. The most common infective agent is Shigella ; Entamoeba histolytica is more frequent in older children and adults, but is rarely seen in children under age 5 years.

Bloody stools are generally frequent but small, and are therefore rarely accompanied by signs of dehydration. Fever, pain in the rectum during defecation and cramping abdominal pain are often experienced, on the other hand.

Approximately 15 % of episodes of diarrhoea in children are caused by dysentery, whereas 25 % of all diarrhoeal deaths may be ascribed to it. Although dysentery produces little or no dehydration, its other complications may be fatal. They include intestinal perforation, toxic megacolon, convulsions, septicaemia and haemolytic-uraemic syndrome. Anorexia, fever and protein loss during enteropathy may cause undernutrition.

In emergency situations it is rarely possible to make an aetiological diagnosis. For this reason, children with dysentery should be presumed to have shigellosis (involved in 60 % of dysenteries and almost all serious cases), unless otherwise proved. An oral antibiotic to which most shigellas in the region are sensitive should be administered for 5 days.

The antibiotics usually recommended for treatment of shigellosis are cotrimoxazole, nalidixic acid and ampicillin. When no improvement is seen after two days of treatment with the antibiotic recommended by the national policy, a change of antibiotic is called for. If two days of this treatment are not effective, the patient should be referred to a hospital.

Use of an amoebicide is only useful when microscopy reveals the presence of Entamoeba histolytica trophozoites, or in the absence of clinical improvement following consecutive treatment with two antibiotics. Rehydration and maintaining of a satisfactory nutritional status (or renutrition) are also important in treating shigellosis.

PERSISTENT DIARRHOEA

Persistent diarrhoea is defined as an episode lasting 14 days or longer. Malnutrition, age under 18 months, recent introduction of animal milk or powdered milk (for an infant) and immunocompromise are contributive factors. Irrespective of its cause, persistent diarrhoea is accompanied by extensive damage to the intestinal mucosa, with flattening of the villi and reduced production of disaccharidase enzymes, which are active in the absorption of carbohydrates. These may perpetuate reduced intestinal absorption as well as diarrhoea after the original infective agent has been eliminated. The nutritional impact is then serious, and frequently results in considerable weight loss, marasmus and/or vitamin and mineral deficiencies.

(1) Cf. *appendix* **6**.

50

For rehydration, the oral route is usually sufficient. Weight gain, as well as the gradual subsiding of diarrhoea, will be achieved by nutritional measures :

- continue breast-feeding for suckling babies ;

- dilute animal milk with an equal amount of water or replace it with a fermented dairy product such as yoghurt ;

- avoid stringy, fibrous foods, especially those eaten raw ;

- supply large amounts of energy, proteins, vitamins and minerals to help repair the intestinal mucosa ; food should be mashed or finely ground, to facilitate digestion and intestinal absorption of nutrients ;

- avoid hyperosmolar (too salted or too sweet) food or drink (especially soft drinks or commercial fruit drinks, which are usually overly sweet) ;

- give food in frequent, small meals (at least 6), giving thick cereal with added oil, vegetables, legumes, meat or fish ; provide additional vitamins and minerals whenever possible .

In case of bloody stools or detection of Shigella by culture, the child should be given effective anti-shigella antibiotherapy. When another pathogen is identified, the appropriate antibiotic (or anti-protozoal agent) should be provided. Conversely, treatment with an antibiotic or with an "antidiarrhoeal agent" (inhibitors of intestinal motility, adsorbents or antisecretory drugs) should not be prescribed "blindly" : they are ineffective and may have an adverse effect.

FEVER AND DIARRHOEA

Children with diarrhoea frequently have a fever. It is particularly frequent when diarrhoea is caused by a rotavirus or an invasive bacterium. Fever may also accompany dehydration, and reciprocally, it accelerates it.

In the presence of a fever, a parenteral infection such as otitis, pneumonia, meningitis, malaria, etc. should be sought ; if any of these are found, an appropriate medication should be given. Conversely, it is not appropriate to give antibiotics to a child simply because he/she has diarrhoea.

Children with fever who live in an area where there is falciparum malaria should be given an antimalarial. When the fever exceeds 39°C it should be lowered with the help of an antipyretic such as paracetamol, and by simple means such as sponging the head and abdomen with tepid water, and fanning.

DIARRHOEA AND AIDS

Persistent diarrhoea is one of the main clinical signs of AIDS in the tropics (an episode of diarrhoea lasting more than 30 days, according to the WHO definition of AIDS in children). There are often one or several other signs of the disease, such as considerable weight loss, fever and/or a lasting lung disease, systemic lymphadenopathy, buccopharyngeal candidiasis, or again, diffuse dermatosis.

As a rule, no pathogen can be identified. When the germ is known, it is generally a protozoan, usually cryptosporidium (occasionally Isospora).

Treatment management is the same as for any other persistent diarrhoea. An antibiotic should only be prescribed in the presence of an identified germ that responds well to treatment.

Aetiological diagnosis is based on a positive ELISA test. However, interpretation of this test in children under age one year is often difficult because of false positive reactions due to maternal antibodies.

The prevention of HIV infection in children involves :

- prevention of HIV infection in the mother ;

- prevention of HIV infection in the child, by keeping blood transfusions to a minimum and avoiding use of potentially contaminated material such as needles.

MANAGEMENT OF CHOLERA PATIENTS[1]

Cholera should be suspected in a patient over 5 years of age when an episode of acute, watery diarrhoea (generally accompanied by vomiting) induces severe dehydration, or when a patient over two years of age suffers from acute, watery diarrhoea in a region where cholera is a problem.

When cholera is suspected in a child, the steps described in the previous chapters should be followed ; first, look for signs of dehydration, then rehydrate the patient and keep a close watch on him/her before reassessing the hydration status. Maintain hydration by compensating for fluid losses until the diarrhoea is over. Renourish the patient, but also, administer an oral antibiotic to severely dehydrated patients.

Administration of an antibiotic

When administered to severely dehydrated patients, an effective antibiotic reduces the volume and duration of severe choleric diarrhoea, as well as the duration of excretion of the Vibrio cholerae 01.

Antibiotherapy should begin as soon as vomiting has stopped, which is usually after 3 to 4 hours of oral rehydration. Injectable antibiotics are expensive and have no special advantages. No other medication should be given to treat cholera : antidiarrhoeals, antiemetics, antispasmodics, cardiotonics and corticosteroids, in particular, should absolutely be proscribed. Blood transfusions and macromolecular serum substitute solutions (Dextran) are unnecessary.

The following table shows the type and dosage of antibiotics commonly prescribed in severe cases of cholera. In regions where cholera is present, it is important to identify those antibiotics to which the Vibrio Cholerae 01 is resistant. If diarrhoea persists after 48 hours of treatment, resistance to the antibiotic should be suspec-

(1) WHO/CDD/SER/91.5 Rev. 1 (1992).

ted. Furthermore, it should be recalled that sulfadoxine and Fanasil are definitely never effective in treating cholera.

Table 9
Antibiotics used in the treatment of cholera

Antibiotics [a]	Children	Adults
Doxycycline once	--------	300 mg [b]
Tetracycline 4 times a day for 3 days	12.5 mg/kg	500 mg
Trimethroprim (TMP) sulfamethoxazole (SMX) twice a day for 3 days	TMP 5 mg/kg and SMX 25 mg/kg [c]	TMP 160 mg SMX 800 mg
Furazolidone 4 times a day for 3 days	1.25 mg/kg	100 mg [d]

(a) Erythromycin and chloramphenicol may also be used when none of the other recommended antibiotics are available, or when Vibrio Cholerae 01 is resistant to the latter.
(b) Doxycycline is the antibiotic of choice for adults (excepting pregnant women), since a single dose suffices.
(c) TMP-SMX is the antibiotic of choice for children. Tetracycline is equally effective, but is not available everywhere in paediatric form.
(d) Furazolidone is the antibiotic of choice for pregnant women.

VACCINES

Antidiarrhoea vaccines

It is important to be informed of the state of advancement of research on this subject. However, two points should be kept in mind, to avoid generating too many illusions as to the impact of such research on the everyday work of health personnel.

First, many germs may cause diarrhoea, and each vaccine is specifically directed against one particular agent. Prevention of all episodes of diarrhoea by immunization is impossible, since it would require the development of too many vaccines. The ideal solution would be the association of vaccines combating the most frequently encountered diarrhoea-causing germs. At present, the development of an anti-rotavirus or anti-shigella vaccine would be extremely valuable.

In addition, the diarrhoea prevention and treatment activities described above remain essential. They require patient work, day after day, and should not be replaced by more costly, less effective interventions.

Research is presently concentrating on vaccines against rotavirus infections and against cholera, shigelloses and conditions caused by enterotoxigenic Escherichia coli.

Anti-rotavirus vaccines

Trials aimed at evaluating their effectiveness, safety and immunogenicity are presently under way. The development of these vaccines, based on the rhesus monkey, bovine or human rotavirus, is difficult owing to the many serotypes, to the adverse reactions elicited and to the moderate immune responses. Tetravalent rhesus rotavirus plus reassorted monkey/human rotaviruses seem most promising at present. Once these vaccines have proved definitely effective, more thorough studies on any possible interference with the oral polio virus will be required to determine how large a dose of antirotavirus vaccine may be administered in the framework of the Expanded Programme for Immunization (EPI).

Cholera vaccines

Because of its limited effectiveness, the old, parenterally administered cholera vaccine is no longer viewed as valuable from a public health perspective. Attention has now turned to the development of oral vaccines capable of highly effective stimulation of local immunity. Killed and live oral vaccines have been developed.

Killed, whole-germ vaccines (WCV) reinforced with *B* subunits (WCV/B), administered in 3 doses at 6-week intervals, have been found to afford approximately 68 % protection to children over age 5 years for a 3-year period. Vaccinal effectiveness was similar in younger children (3 to 5 years), but it declined rapidly after 6 months.

The presently experimented live vaccine is the CVD - 103HgR strain of Vibrio Cholerae 01. The immunologically effective, safe dose has been ascertained. Field trials are now being planned for the evaluation of its effectiveness in affording protection in regions with pandemic or epidemic cholera.

Anti-shigella vaccines

Two approaches to candidate vaccines are currently under study : genetic engineering and non-virulent mutants. However, neither of these approaches has as yet resulted in the development of a product that is ready for clinical field trials.

Anti-enterotoxigenic escherichia coli vaccines (ETEC)

A prototype containing formol-killed germs and the B subunit of the cholera toxin (justified by the protection against toxic diarrhoea afforded by this subunit) is presently being experimented in Sweden. Subsequent phases will include trials on travellers and children.

Antityphoid fever vaccines

Two vaccines are available at present ; they are less active than the conventional vaccine.

One of these, the TY21a, is administered orally. At least 3 doses of the vaccine are required to achieve protection lasting at least 5 years. The other is prepared from the Vi antigen extracted from the salmonella Typhi. One injectable dose protects 70 % of adults for at least 2 years. The length of protection in children has not been determined.

CONCLUSION

Throughout this presentation of the various aspects of the control of diarrhoeal diseases, it has been clear that to be effective, any action in that direction is necessarily complex, owing to the many,

varied factors which affect the incidence, seriousness and duration of diarrhoea. These include nutritional and health status, immune status, household hygiene and socioeconomic and educational levels, housing, water supplies, waste disposal, food consumption, etc. In the light of these multifactorial influences, it is easier to understand why noteworthy improvement can only be achieved through multisectorial initiatives.

It is a fact, however, that health services are too often the only ones to concern themselves with diarrhoea, although many other agencies should include it among the priorities for their programmes, and work within genuinely multidisciplinary teams. Some officials view diarrhoea prevention as mainly requiring wide-ranging programmes for supplying clean water, and installing sewerage, waste and excrement disposal systems. Such projects require extremely costly work and will not reach communities everywhere for a long time to come. Furthermore, if they are to be fully effective they must be preceded, accompanied and followed by communication and educational programmes.

Even within health action, activities aimed exclusively at preventing and treating diarrhoea cannot be hoped to solve the problem. They must work side by side with other action, and more specifically with work in food and diet, immunization and individual and domestic hygiene.

In these pages, special emphasis has been placed on the dietary and nutritional aspect, which was sorely neglected for many years, in both national and international programmes. In good logic, the relationship between food and diet and diarrhoea is seen to be quite natural, and control measures should concentrate simultaneously on both axes : rehydration and diet.

Most interventions should take community behavioural patterns into consideration : these should not be viewed as simple "ways of acting", but as values, meaningful acts, with reasons behind them. There is no single all-purpose programme ; the first thing to do is to work with the population at analysing its behaviour, understanding the whies and wherefores of any given act, and its consequences ; then, later on, an attempt is made, in collaboration with the families involved, to work out possible improvements. The behaviour-understanding approach is part of the same strategy as the epidemiological and clinical analysis of the situation.

Before suggesting changes to improve the situation, technicians must be scientifically sure of the validity of their proposals. Let us take the example of the control of houseflies, known for ages to be vectors of disease, and regarded by many health agents and by the population itself as transmitting diarrhoea. At present, a review of most epidemiological research shows the existence of a correlation between flies and diarrhoeal diseases, but these studies are outdated and suffer from methodological shortcomings which do not make them adequate proof that flies are actually major vectors of diarrhoeal diseases in young children. It is a fact that they may

transmit this disease, but they do not seem to be the leading route of transmission. This means that a programme aimed at diarrhoea control should not demand of the population that it concentrate much of its efforts on combating flies, a task which is difficult and in fact discouraging to undertake and to evaluate, and even more, to pursue over time. In addition to which, there is no definite proof of its impact on contamination.

It is important to encourage studies aimed at evaluating the impact of various control measures so as to attain improved targeting of the combined efforts of governments and families, given the dearth of resources, keeping in mind the need to concentrate on two themes, at the least : control of diarrhoea in children and food and diet.

Appendix 1

TREATMENT PLAN A
TO TREAT DIARRHOEA AT HOME [1]

USE THIS PLAN TO TEACH THE MOTHER TO :

- Continue to treat at home her child's current episode of diarrhoea.
- Give early treatment for future episodes of diarrhoea.

EXPLAIN THE THREE RULES FOR TREATING DIARRHOEA AT HOME :

1. GIVE THE CHILD MORE FLUIDS THAN USUAL TO PREVENT DEHYDRATION :

   - Use a recommended home fluid, such as a cereal gruel. If this is not possible, give plain water. Use ORS solution for children described in the box below.

   Note : If the child is under 6 months old and is not yet taking solid food, give ORS solution or water rather than a food-based fluid.

   - Give as much of these fluids as the child will take. Use the amounts shown below for ORS as a guide.
   - Continue giving these fluids until the diarrhoea stops.

2. GIVE THE CHILD PLENTY OF FOOD TO PREVENT UNDERNUTRITION :

   - Continue to breast-feed frequently.
   - If the child is not breast-fed, give the usual milk. If the child is less than 6 months old and not yet taking solid food, dilute milk or formula with an equal amount of water for 2 days.
   - If the child is 6 months or older, or already taking solid food :
   - Also give cereal or another starchy food mixed, if possible, with pulses, vegetables, and meat or fish. Add 1 or 2 teaspoonfuls of vegetable oil to each serving.
   - Give fresh fruit juice or mashed banana to provide potassium.
   - Give freshly prepared foods. Cook and mash or grind food well.
   - Encourage the child to eat ; offer food at least 6 times a day.
   - Give the same foods after diarrhoea stops, and give an extra meal each day for two weeks.

3. TAKE THE CHILD TO THE HEALTH WORKER IF THE CHILD DOES NOT GET BETTER IN 3 DAYS OR DEVELOPS ANY OF THE FOLLOWING :

   - Many watery stools
   - Repeated vomiting
   - Marked thirst
   - Eating or drinking poorly
   - Fever
   - Blood in the stool

(1) WHO/CDD/SER/80.2 Rev.2 (1990).

CHILDREN SHOULD BE GIVEN ORS SOLUTION AT HOME, IF :

- *They have been on treatment Plan B or C.*
- *They cannot return to the health worker if the diarrhoea gets worse.*
- *It is national policy to give ORS to all children who see a health worker for diarrhoea.*

IF THE CHILD WILL BE GIVEN ORS SOLUTION AT HOME, SHOW THE MOTHER HOW MUCH ORS TO GIVE AFTER EACH LOOSE STOOL AND GIVE HER ENOUGH PACKETS FOR 2 DAYS :

Age	Amount of ORS to give after each loose stool	Amount of ORS to provide for use at home
Less than 24 months	50-100 ml	500 ml/day
2 up to 10 years	100-200 ml	1 000 ml/day
10 years or more	As much as wanted	2 000 ml/day

- Describe and show the amount to be given after each stool using a local measure.

SHOW THE MOTHER HOW TO MIX ORS.

SHOW HER HOW TO GIVE ORS :

- Give a teaspoonful every 1-2 minutes for a child under 2 years.
- Give frequent sips from a cup for an older child.
- If the child vomits, wait 10 minutes. Then give the solution more slowly (for example, a spoonful every 2-3 minutes).
- If diarrhoea continues after the ORS packets are used up, tell the mother to give other fluids as described in the first rule above or return for more ORS.

Appendix 2

TREATMENT PLAN B
TO TREAT DEHYDRATION [1]

APPROXIMATE AMOUNT OF ORS SOLUTION TO GIVE IN THE FIRST 4 HOURS :

Age(1)	less than 4 months	4-11 months	12-23 months	2-4 years	5-14 years	15 yrs or older
Weight (kg)	less than 5	5-7.9	8-10.9	11-15.9	16-29.9	30 or more
ORS solution (ml)	200-400	400-600	600-800	800-1,200	1,200-2,200	2,200-4,000

(1) Use the patient's age only when you do not know the weight. The approximate amount of ORS required (in ml) can also be calculated by multiplying the patient's weight (in kg) times 75.

- If the child wants more ORS than shown, give more.
- Encourage the mother to continue breast-feeding.
- For infant under 6 months who are not breast-fed, also give 100-200 ml clean water during this period.

OBSERVE THE CHILD CAREFULLY AND HELP THE MOTHER GIVE ORS SOLUTION :

- Show her how much solution to give her child.
- Show her how to give it - a teaspoonful every 1-2 minutes for a child under 2 years, frequent sips from a cup for an older child.
- Check from time to time to see if there are problems.
- If the child vomits, wait 10 minutes and then continue giving ORS, but more slowly, for example, a spoonful every 2-3 minutes.
- If the child's eyelids become puffy, stop ORS and give plain water or breast milk. Give ORS according to Plan A when the puffiness is gone.

AFTER 4 HOURS, REASSESS THE CHILD USING THE ASSESSMENT CHART. THEN SELECT PLAN A, B, OR C TO CONTINUE TREATMENT.

- If there are no signs of dehydration, shift to Plan A. When dehydration has been corrected, the child usually passes urine and may also be tired and fall asleep.
- If signs indicating some dehydration are still present, repeat Plan B, but start to offer food, milk and juice as described in Plan A.
- If signs indicating severe dehydration have appeared, shift to Plan C.

(1) WHO/CDD/SER/80.2 Rev.2 (1990).

IF THE MOTHER MUST LEAVE BEFORE COMPLETING TREATMENT PLAN B :

- Show her how much ORS to give to finish the 4-hour treatment at home.
- Give her enough ORS packets to complete rehydration and for 2 more days as shown in Plan A.
- Show her how to prepare ORS solution.
- Explain to her the three rules in Plan A for treating her child at home :

- to give ORS or other fluids until diarrhoea stops.
- to feed the child.
- to bring the child back to the health worker, if necessary.

Appendix 3

TREATMENT PLAN C

TO TREAT SEVERE DEHYDRATION QUICKLY [1]

FOLLOW THE ARROWS. IF ANSWER IS "YES", GO ACROSS.
IF "NO", GO DOWN

START HERE

Can you give intravenous (IV) fluids immediately ?

YES →

- Start IV fluids immediately. If the patient can drink, give ORS by mouth while the drip is set up. Give 100 ml/kg Ringer's Lactate Solution (or, if not available, normal saline), divided as follows :

Age	First give 30 ml/kg in :	Then give 70 ml/kg in :
Infants (under 12 months)	1 hour*	5 hours
Older	30 minutes*	2 1/2 hours

**Repeat once if radial pulse is still very weak or not detectable.*

- Reassess the patient every 1-2 hours. If hydration is not improving, give the IV drip more rapidly.
- Also give ORS (about 5 ml/kg/hour) as soon as the patient can drink : usually after 3-4 hours (infants) or 1-2 hours (older patients).
- After 6 hours (infants) or 3 hours (older patients), evaluate the patient using the assessment chart. Then choose the appropriate Plan (A, B, or C) to continue treatment.

NO ↓

Is IV treatment available nearby (within 30 minutes)?

YES →

- Send the patient immediately for IV treatment.
- If the patient can drink, provide the mother with ORS solution and show her how to give it during the trip.

↓

61

(1) WHO/CDD/SER/80.2. Rev. 2 (1990).

NO

Are you trained to use a naso-gastric (NG) tube for rehydration?

YES

- Start rehydration by tube with ORS solution : give 20 ml/kg/hour for 6 hours (total of 120 ml/kg).
- Reassess the patient every 1-2 hours :
  - If there is repeated vomiting or increasing abdominal distension, give the fluid more slowly.
  - If hydration is not improving after 3 hours, send the patient for IV therapy.
- After 6 hours, reassess the patient and choose the appropriate Treatment Plan.

NO

Can the patient drink?

YES

- Start rehydration by mouth with ORS solution, giving 20 ml/kg/hour for 6 hours (total of 120 ml/kg).
- Reassess the patient every 1-2 hours :
  - If there is repeated vomiting, give the fluid more slowly.
  - If hydration is not improving after 3 hours, send the patient for IV therapy.
- After 6 hours, reassess the patient and choose the appropriate Treatment Plan.

NO

URGENT : send the patient for IV or NG treatment

NOTES :

- If possible, observe the patient at least 6 hours after rehydration to be sure the mother can maintain hydration giving ORS solution by mouth.
- If the patient is above 2 years and there is cholera in your area, give an appropriate oral antibiotic after the patient is alert.

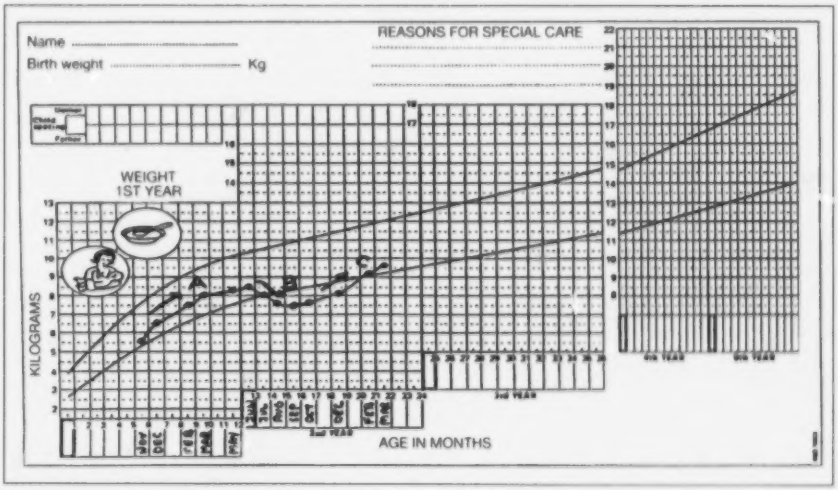
Appendix 4

GROWTH CHART[1]

Below is an example of a growth chart that can be used for plotting the changes in body weight of an infant or young child. As maintenance of good nutrition is important in the prevention of diarrhoea, an episode of diarrhoea is an excellent time to start using a growth chart, if one is not already being used.

The infant or young child should be weighed at regular intervals and the weight entered on the chart in the vertical column corresponding to the child's age. The value of a growth chart is not to determine the nutritional status of a child at a particular time. Rather, its principal use is to monitor growth over time by measuring changes in weight (an example of a child's growth curve is shown on the chart below). If the direction of the line joining successive weights is upwards and parallel to the solid lines (arrows A and C on chart), the child is growing satisfactorily. A downward or horizontal direction of the line (arrow B on chart) is a sign of inadequate nutrition and/or illness. These patterns are especially helpful in the first year of life ; in older children slight fluctuations in growth normally occur without signalling danger.

The curved lines that run across the chart show the shape of normal growth curves. The growth curves of most healthy children will lie between these lines or above the upper line. If a child's weight is much below the lower reference line there is some reason for concern. However, even in this case, it is the direction of the child's growth curve that is most important.



(1) WHO/CDD/SER/80.2 Rev.2 (1990).

Appendix 5

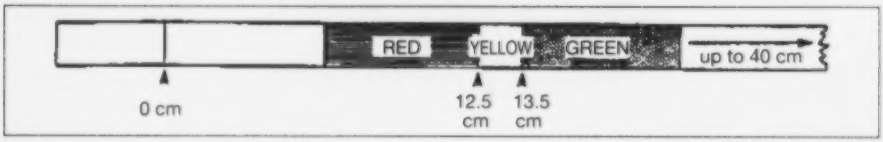
HOW TO DETERMINE IF A CHILD IS UNDERNOURISHED [1]

The upper arm has a bone, muscles and fat. When babies are about 1 year old, they have quite a lot of fat under the skin of their arms. When they are 5 years old, there is much less fat and more muscle. The distance around the upper arm remains almost the same between the ages of 1 and 5 years. If a child is undernourished, this distance is reduced, and his arm becomes thin. This is due to reduction in muscles and fat. By placing a special measuring strip around the upper arm one can find out whether a child between the ages of 1 and 5 is undernourished or not.

Measurement of a child's arm circumference is useful in evaluating the risk of malnutrition. The WHO classification shown here is applied to the figures obtained.

Arm circumference	Risk of malnutrition
< 12.5 cm	Risk of severe malnutrition
12.5 - 13.5 cm	Risk of moderate malnutrition
> 13.5 cm	Risk of slight malnutrition/no risk

This measuring strip is called a tri-coloured arm strip and looks like this :



You can make one from a strip of material that does not stretch, being careful that the markings are accurate.

To use this strip : put it around the mid upper arm of the child and see which colour is touched by the 0 cm mark on the strip.

Green : arm circumference greater than 13.5 cm.

Yellow : arm circumference 12.5 - 13.5 cm.

Red : arm circumference below 12.5 cm.

(1) WHO/CDD/SER/80.2. Rev. 2 (1990).

Appendix 6

MANAGEMENT OF ASSOCIATED PROBLEMS [1]

ASK ABOUT BLOOD IN THE STOOL

IF BLOOD IS PRESENT :

- Treat for 5 days with an oral antibiotic recommended for Shigella in your area.
- Teach the mother to feed the child as described in Plan A.
- See the child again after 2 days if :
  - under 1 year of age ;
  - initially dehydrated ;
  - there is still blood in the stool ;
  - not getting better ;
- If the stool is still bloody after 2 days, change to a second oral antibiotic recommended for Shigella in your area. Give it for 5 days.

ASK WHEN THIS EPISODE OF DIARRHOEA BEGAN

IF DIARRHOEA HAS LASTED AT LEAST 14 DAYS :

- Refer to hospital if :
  - the child is under 6 months old
  - dehydration is present (Refer the child after treatment of dehydration)
- Otherwise, teach the mother to feed her child as in Plan A, except :
  - dilute any animal milk with an equal volume of water or replace it with a fermented milk product, such as yoghurt.
  - assure full energy intake by giving 6 meals a day of thick cereal and added oil, mixed with vegetables, pulses, meat, or fish.
- Tell the mother to bring the child back after 5 days :
  - if diarrhoea has not stopped, refer to hospital.
  - if diarrhoea has stopped, tell the mother to :
    - use the same foods for the child's regular diet.
    - after 1 more week, gradually resume the usual animal milk.
    - give an extra meal each day for at least 1 month.

LOOK FOR SEVERE UNDERNUTRITION

IF THE CHILD HAS SEVERE UNDERNUTRITION :

- Do not attempt rehydration ; refer to hospital for management.
- Provide the mother with ORS solution and show her how to give 5 ml/kg/hr during the trip.

(1) WHO/CDD/SER/80.2 Rev.2 (1990).

ASK ABOUT FEVER AND TAKE TEMPERATURE

IF THE CHILD IS UNDER 2 MONTHS OF AGE :

- Rehydrate as necessary. If there is fever (38° C or above) after rehydration, refer to hospital. Do not give paracetamol or an antimalarial.

IF THE CHILD IS 2 MONTHS OF AGE OR OLDER :

- If temperature is 39° C or above, give paracetamol.
- If there is falciparum malaria in the area, and the child has any fever (38° C or above) or history of fever in the past 5 days, give an antimalarial (or manage according to your malaria programme recommendation).

DID YOU KNOW?

1. Other helpful documents on diarrhoea

Dialogue on Diarrhoea. Quarterly bulletin. London : Appropriate Health resources and Technologies Action Groupe Ltd. (AHRTAG - 85, Marylebone High Street, London W1M 3DE).

Diarrhoeal diseases. Bibliographic bulletin. Paris : International Children's Centre, 1990 ; n° 13.

MASSE-RAIMBAULT A-M. Feeding babies : from breast milk to the family dish. Children in the Tropics. 1992 ; n° 202/203.

WHO. A manual for the treatment of diarrhoea. For use by physicians and other senior health workers. Geneva : WHO/CDD/SER/80.2 Rev.2 1990.

WHO. Programme for Control of Diarrhoeal Diseases. Geneva : WHO/CDD/SER/90.13.

2. Pharmacists too are concerned by diarrhoea

International Action for Health (AIS) has undertaken research to evaluate the attitude adopted by pharmacists when faced with mothers whose children have diarrhoea (Cf. AIS Nicaragua, Bulletin n° 2, July 1992).

The survey worker, a woman medical student, visited 20 of the 23 pharmacies located in Matagalpa, Nicaragua, during the month of July 1992. She pretended to be a poor mother seeking advice on how to treat her child's diarrhoea. The signs shown by the diarrhoeic child had been defined in detail beforehand, in case the pharmacist asked questions : it was an 18-month-old child with diarrhoea over the past 24 hours, with 8 watery stools, vomiting, thirst and a low-grade fever.

In 14 of the pharmacies investigated (70 %) only the child's age was asked ; in another 2 (10 %) some questions which pointed to the high probability of dehydration were asked. In 11 (55 %), a cotrimoxazole jarabe-based drug was offered, whereas 9 (45 %) only suggested one of the inadequate or even potentially toxic antidiarrhoeal agents.

None of the pharmacies advised the mother to consult a doctor or to take her child to a health facility for treatment of probable dehydration. Nor were oral rehydration salts ever mentioned, or was a doctor's prescription requested for the purchasing of an antibiotic, which would have been the correct attitude.

This tends to prove that in some countries pharmacists and their personnel should be included in any information programme.

3. A consensus statement on "HIV transmission and breast-feeding" has been issued.

The current lively controversy over transmission of the HIV by breast milk has led the periodical "Famille, Santé, Développement" (n° 25. December 1992. Kigali) to publish the 1992 WHO/UNICEF statement on this issue. The integral version of this consensus statement, with its appended recommendations, is reproduced here.

In view of the importance of breast milk and breast-feeding for the health of infants and young children, the increasing prevalence of human immunodeficiency virus (HIV) infection around the world, and recent data concerning HIV transmission through breast milk, a Consultation on HIV Transmission and Breast-feeding was held by WHO and UNICEF from 30 April to 1 May 1992. Its purpose was to review currently available information on the risk of HIV transmission through breast milk and to make recommendations on breast-feeding.

Based on the various studies conducted to date, roughly one-third of the babies born worldwide to HIV-infected women become infected themselves, with this rate varying widely in different populations. Much of this mother-to-infant transmission occurs during pregnancy and delivery, and recent data confirm that some occurs through breast-feeding. However, the large majority of babies breast-fed by HIV-infected mothers do not become infected through breast milk. Recent evidence suggests that the risk of HIV transmission through breast-feeding (a) is substantial among women who become infected during the breast-feeding period, and (b) is lower among women already infected at the time of delivery. However, further research is needed to quantify the risk of HIV transmission through breast-feeding and determine the associated risk factors in both of these circumstances.

Studies continue to show that breast-feeding saves lives. It provides impressive nutritional, immunological, psychosocial and child-spacing benefits. Breast-feeding helps protect children from dying of diarrhoeal diseases, pneumonia and other infections. For example, artificial or inappropriate feeding is a major contributing factor in the 1.5 million annual infant deaths from diarrhoeal diseases. Moreover, breast-feeding can prolong the interval between births and thus make a further contribution to child survival, as well as enhancing maternal health.

It is therefore important that the baby's risk of HIV infection through breast-feeding be weighed against its risk of dying of other causes if it is denied breast-feeding. In each country, specific guidelines should be developed to facilitate the assessment of the circumstances of the individual woman.

RECOMMENDATIONS

1. In all populations, irrespective of HIV infection rates, breast-feeding should continue to be protected, promoted and supported.

2. Where the primary causes of infant deaths are infectious diseases and malnutrition, infants who are not breast-fed run a particularly high risk of dying from these conditions. In these settings, breast-feeding should remain the standard advice to pregnant women, including those who are known to be HIV-infected, because their baby's risk of becoming infected through breast milk is likely to be lower than its risk of dying of other causes if deprived of breast-feeding.The higher a baby's risk of dying during infancy, the more protective breast-feeding is and the more important it is that the mother be advised to breast-feed. Women living in these settings whose particular circumstances would make alternative feeding an appropriate option might wish to know their HIV status to help guide their decision about breast-feeding. In such cases, voluntary and confidential HIV testing accompanied in all cases by pre- and post-test counselling could be made available where feasible and affordable.

3. In settings where infectious diseases are not the primary causes of death during infancy, pregnant women known to be infected with HIV should be advised not to breast-feed but to use a safe feeding alternative for their babies. Women whose infection status is unknown should be advised to breast-feed. In these settings, where feasible and affordable, voluntary and confidential HIV testing should be made available to women along with pre- and post-test counselling, and they should be advised to seek such testing before delivery.

4. When a baby is to be artificially fed, the choice of substitute feeding method and product should not be influenced by commercial pressures. Companies are called on to respect this principle in keeping with the international Code of Marketing of Breast-milk Substitutes and all relevant World Health Assembly resolutions. It is essential that all countries give effect to the principles and aim of the International Code. If donor milk is to be used, it must first be pasteurized and, where possible, donors should be tested for HIV. When wet-nursing is the chosen alternative, care should be taken to select a wet-nurse who is at low risk of HIV infection and, where possible, known to be HIV-negative.

5. HIV-infected women and men have broad concerns, including maintaining their own health and well-being, managing their economic affairs, and making future provision for their children, and therefore require counselling and guidance on a number of important issues. Specific issues to be covered by counselling include infant feeding practices, the risk of HIV transmission to the offspring if the woman becomes pregnant, and the transmission risk from or to others through sexual intercourse or blood. All HIV-infected adults who wish to avoid childbearing should have ready access to family planning information and services.

6. In all countries, the first and overriding priority in preventing HIV transmission from mother to infant is to prevent women of childbearing age from becoming infected with HIV in the first place. Priority activities are (a) educating both women and men about how to avoid HIV infection for their own sake and that of their future children ; (b) ensuring their ready access to condoms ; (c) providing prevention and appropriate care for sexually transmitted diseases, which increase the risk of HIV transmission; and (d) otherwise supporting women in their efforts to remain uninfected.

AVAILABLE ISSUES

■ 1985

154/155* Education on sexuality, the family and society today
156/157* Primary rehabilitation care in Mali
159 Women's lives, mothers' health

■ 1986

160/161* From routine... to epidemiology... to health activities
162/163* Immunization
164 Early mother - child interaction
165 Xerophthalmia and blindness of nutritional origin in the third world

■ 1987

166 Teaching nutrition to young children
167/168* Weaning foods
169 Major haemoglobinopathies
170/171* Proceed with caution... Children under six

■ 1988

172 AIDS, the mother, the child
173/174* Drug system management at the peripheral level
175/176* Strategies for combating endemic goitre
177 Diet, environment and children's development

■ 1989

178 Malaria
179 Genetics and health
180 Health for adolescents and youth
181/182* Nutritional status : the interpretation of indicators
183 Learning how to read... Why ?

■ 1990

184/185* The Bamako Initiative : primary health care experience
186 Nutritional anaemia
187/188* Childbearing and women's health
189 Immunity and nutrition

■ 1991

190/191* New borns... getting a good start
192 Nutrition education
193/194* Controlling fertility
195 The developing child : tools for monitoring

■ 1992

196/197* Childhood tuberculosis, still with us...
198 Evaluating health action in the third world
199/200* Rural agrobusiness
201 Social approaches to infant feeding in urban African settings
202/203* Feeding babies : from breast milk to the family dish

*Double issue.

TO BE PUBLISHED

- Children and television
- Nutritive value and processing of food
- Tiny development projects and the economy
- The ANDES programme in Ecuador

Founder : Prof. J. SÉNÉCAL
Managing Director : Prof. H. DUPIN
Editor in Chief : Dr. A.-M. MASSE-RAIMBAULT
Imprimerie Rosay, 47, avenue de Paris, 94300 Vincennes - Dépôt légal : 2e trimestre 1993 - 21793
N° de commission paritaire : AD 1622 - N° ISSN : 0379-2269

SUBSCRIPTION OR ORDER FORM

LAST NAME : .....

FIRST NAME : .....

PROFESSION : .....

ADDRESS : .....
(Street or P.O. Box)

TOWN : ..... POST CODE : .....

COUNTRY : .....

I order issues numbers :

..... simple issue(s) x US$ 10 (50FF) ☐

..... double issue(s) x US$ 14 (75 FF) ☐

I subscribe (1) to the journal for US$ 40 (220FF) ☐

ENCLOSED FIND THE TOTAL AMOUNT OF ☐

by bank transfert to Banque Transatlantique ☐
RIB 30568 00000 00612545742 39

by check (FF) ☐

by money order ☐

to the order of CENTRE INTERNATIONAL DE L'ENFANCE

RETURN TO : CHILDREN IN THE TROPICS
INTERNATIONAL CHILDREN'S CENTRE
Château de Longchamp
Bois de Boulogne
75016 PARIS (FRANCE)

(1) 6 issues per year

NB : A special price could be allowed for an important order. 71

PUTTING AN END TO DIARRHOEAL DISEASES

1993 - N° 204

In today's world, can we still tolerate the fact that diarrhoea kills some 4 million children under age 5 years each year, not to mention all those who die of another disease worsened by diarrhoea, at a time when a rational approach to the management of acute diarrhoea has been developed?

Following a short review of anatomy and physiology, helpful in understanding the mechanism of water and electrolyte absorption, the authors present clear, simple, practical patterns for intervention in case of dehydration, based on numerous research findings.

How many deaths, how many weeks of disease which deteriorate health and nutritional status and result in considerable wasting of resources, might be avoided if children were appropriately fed during and after episodes of diarrhoea, and if timely, simple action was taken to prevent or treat dehydration, instead of the costly, ineffective or inappropriate treatments which are still too often preferred?

"Sowing seeds in the school garden". Picture by Doctor Edmundo ESTEVEZ. The ANDES programme in Ecuador.

CENTRE INTERNATIONAL DE L'ENFANCE

INTERNATIONAL CHILDREN'S CENTRE
Château de Longchamp
75016 Paris - France
Tél. : (33-1) 45.20.79.92 • Télex 648 379 F
Fax : (33-1) 45.25.73.67